AMERICA
LINK-BELT SPEEDER

1957 ROAD SHOW DISPLAYS TWELVE MILLION DOLLARS WORTH OF EQUIPMENT

HIGHWAY CONSTRUCTION ISSUE

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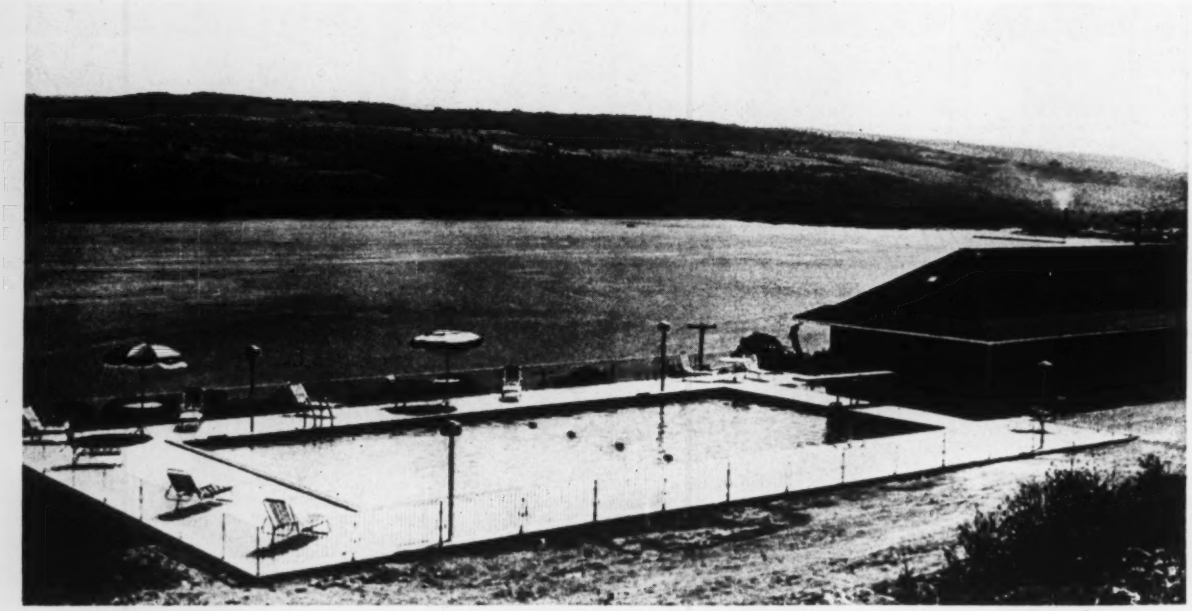
NATIONAL

Complete service and equipment

FOR THE SWIMMING POOL



NATIONAL manufactures and warehouses the most complete line of superior equipment available. NATIONAL fabricates a full line of modern sand pressure filtration systems for both private and public pool applications. These filters are simple to operate, inexpensive to maintain, and deliver fresh sparkling water, free from harmful bacteria.

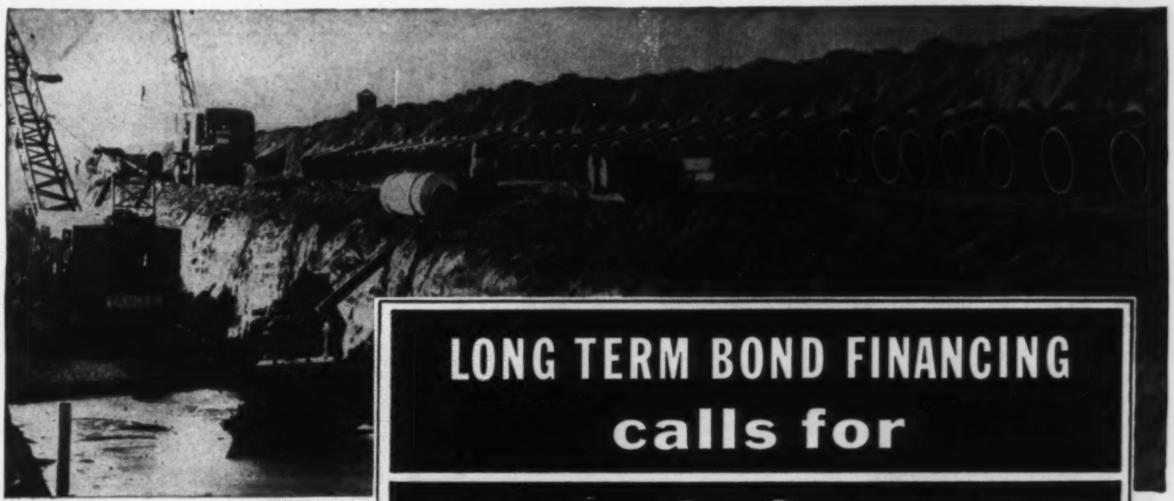
The services of NATIONAL's technical staff are available to architects, engineers, contractors and builders for all types and sizes of pools.

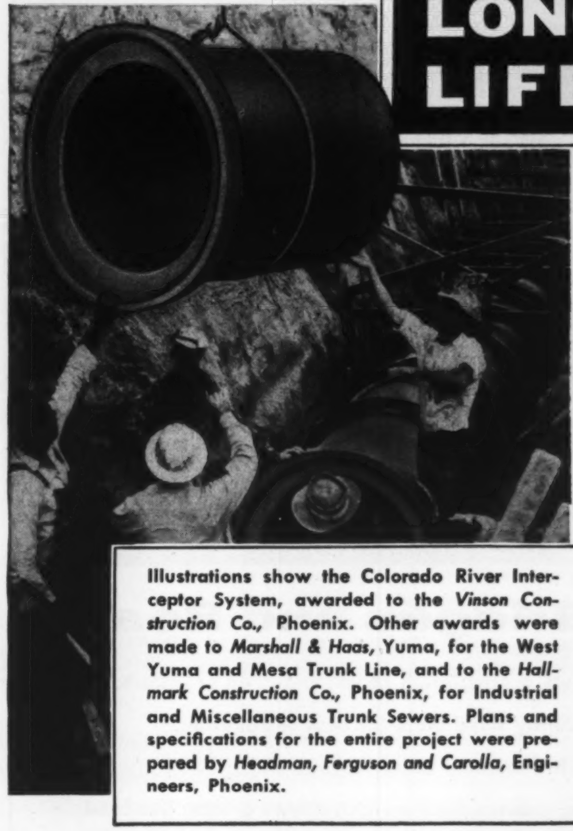
The NATIONAL PRESTRESSED POOL PACKAGE is available in all sizes from 16 x 32 up to any desired dimension for private and public pools. The package includes complete filter system, all fittings, special interlocking concrete units, vertical prestressing bars, marblelite, plans and specifications, and installation instructions. This simplified design eliminates expensive forming or requirement of heavy and expensive construction equipment.

NATIONAL

pool equipment co.

Lee Highway Florence, Alabama Atwater 2-1620





LONG TERM BOND FINANCING calls for LONG LIFE CLAY PIPE

YUMA, ARIZONA, is installing a new $1,600,000 sewer system and pumping plant, designed to meet the demands of its rapidly growing populace. Financed by a bond issue, the project calls for 14 miles of Vitrified Clay Pipe, in diameters up to 36 inches, serving both industrial and residential areas.

When dealing with bond-financed improvements, consulting engineers and civic planners can't afford to take chances. They have to choose materials they know will last. That's why the choice everywhere is Vitrified Clay Pipe. It's the one pipe you can be sure will still be in service long after the bonds have been retired. It's the one pipe that can stand up under the corrosive action of sewer acids and gases . . . can't corrode or disintegrate . . . can't wear out. Its long-term guarantee—*exclusive* with Vitrified Clay Pipe—is striking proof of its superiority.

Illustrations show the Colorado River Interceptor System, awarded to the *Vinson Construction Co.,* Phoenix. Other awards were made to *Marshall & Haas,* Yuma, for the West Yuma and Mesa Trunk Line, and to the *Hallmark Construction Co.,* Phoenix, for Industrial and Miscellaneous Trunk Sewers. Plans and specifications for the entire project were prepared by *Headman, Ferguson and Carolla,* Engineers, Phoenix.

THE PUBLIC *KNOWS* CLAY PIPE IS BEST

Vitrified CLAY PIPE

CLAY PIPE NEVER WEARS OUT!

NATIONAL CLAY PIPE MANUFACTURERS, INC.
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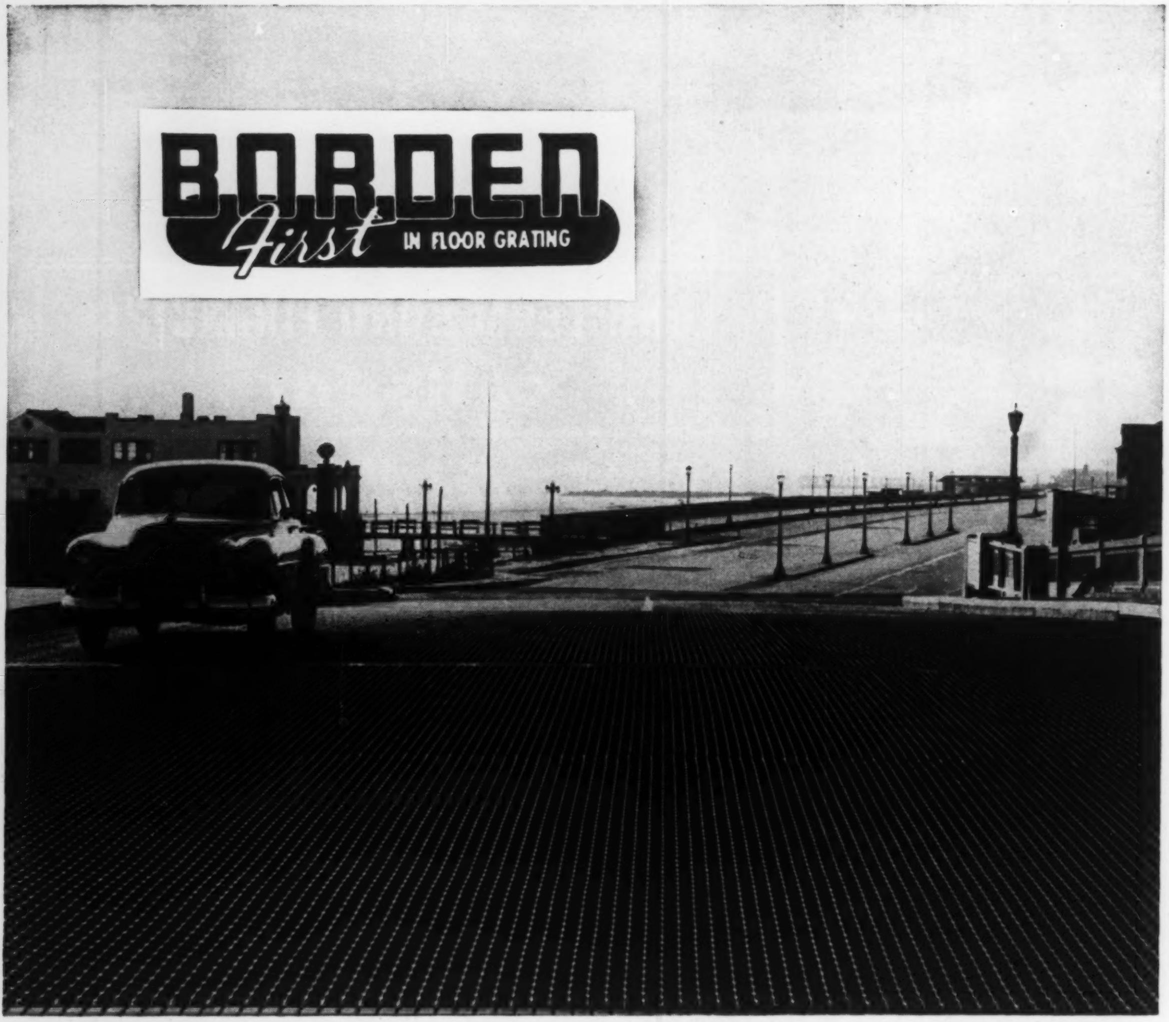

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- **EASY TO INSTALL** — engineered in conveniently sized units for easy installation.
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- **EXCLUSIVE "ROLL-AWAY" MOLDBOARD . . . moves tough dirt fast**
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ROLL-AWAY is an Allis-Chalmers trademark.

These are five of many reasons why Allis-Chalmers FORTY FIVE motor graders are showing up in more and more top construction organizations. They're precisely what you dirt-moving specialists ordered . . . ready now to help you handle the big road-building years ahead. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

Spanall
HORIZONTAL SHORING
FOR ALL BEAM AND SLAB CONCRETE FLOOR FORMS
SPANALL OF THE AMERICAS, INC.
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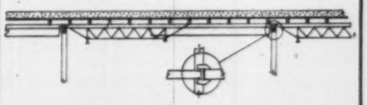
Page 6. Spanall installs fast and easy.


Page 5. Spanall applies to any type of poured concrete construction.

Page 7. Plywood decking laid directly on Spanall.

Newest Catalog features new way to save time, cut costs

Here is practical, profitable information about Spanall, the popular, new, all-metal Horizontal Shoring for concrete forms. Photos, charts and drawings clearly illustrate how Spanall is erected, stripped and stored—with new ease and speed... how Spanall adjusts quickly to any required span length—how Spanall forever eliminates cumbersome, costly vertical shoring... and actually saves as much as 40% in both time and money.

Get *all* the facts about Spanall—it could provide just the competitive advantage you'll need for 1957.

Page 2. Spanall replaces vertical shoring, frees work areas below forms.

SPANALL OF THE AMERICAS, INC.
787 United Nations Plaza, New York 17, N.Y.
Gentlemen—Please send, without cost or obligation, ________ copies of the new Spanall Catalog.

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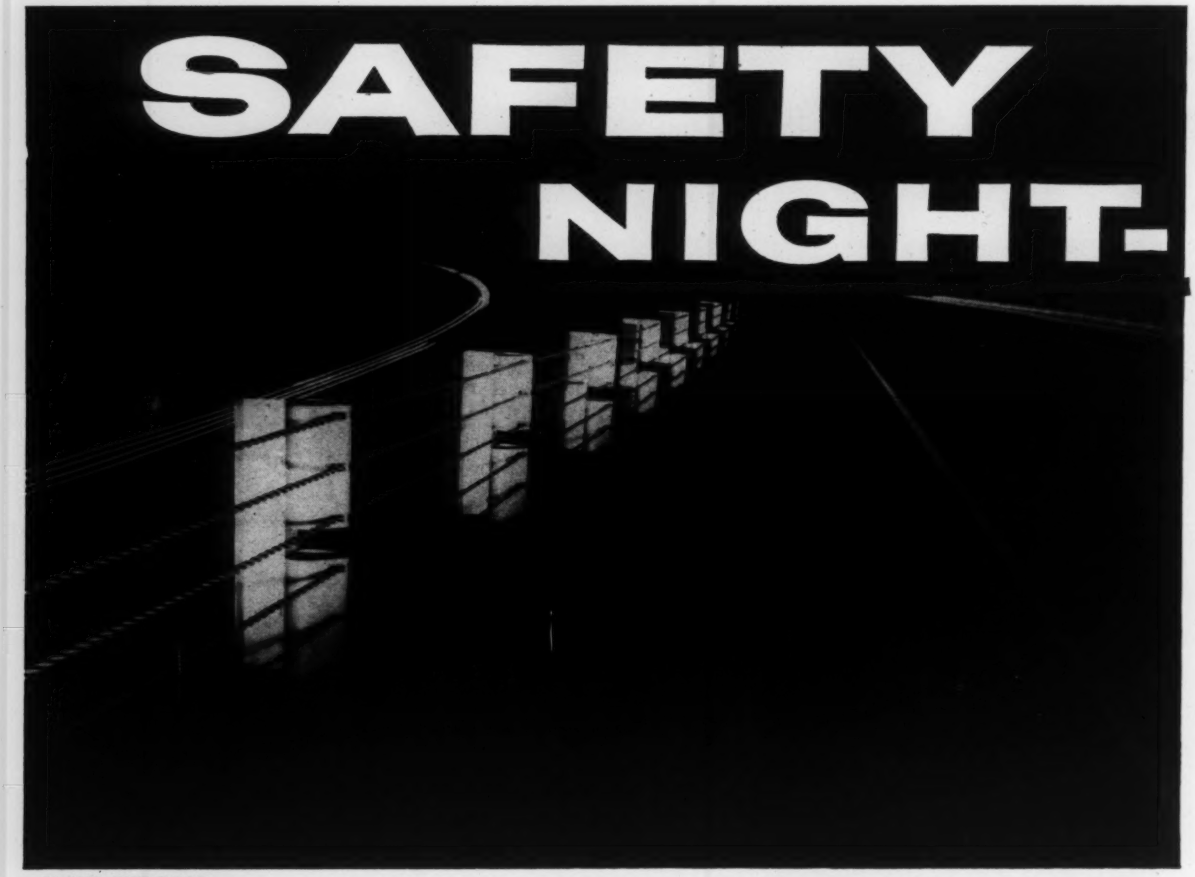


ALONG THE ROAD. Day and night, Multisafty Cable Guard stands guardian of America's newest highways, giving twofold protection from serious accidents. It restrains vehicles from plummeting off the berm. In addition, its resilient combination of strong, steel cables and spring-steel offset brackets cushions the shock of any collision . . . helps prevent damage to the vehicle and injury to passengers.

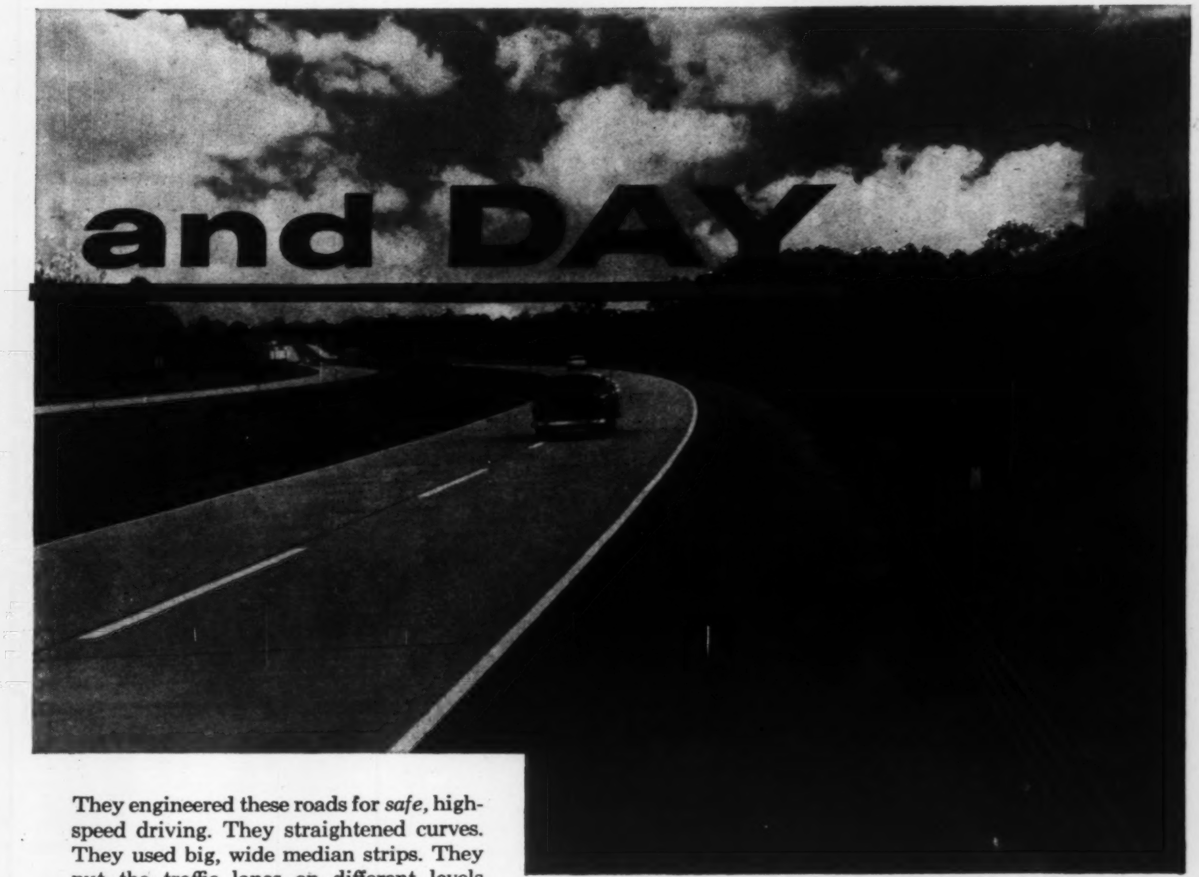
ECONOMY IN CULVERTS.

American Welded Wire Fabric brings the same service-lengthening benefits to culverts as to pavements. Concrete, reinforced with Welded Wire Fabric, is the economical way to build culverts because this combination of materials resists abrasion, has the strength to withstand high stresses, and is easily installed.

SEE The United States Steel Hour. *It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.*

USS Multisafty Highway Guard

USS



They engineered these roads for *safe,* high-speed driving. They straightened curves. They used big, wide median strips. They put the traffic lanes on different levels where possible. Then, they used construction materials manufactured by American Steel & Wire to enhance the basic safety designed into the road.

Materials such as Multisafty Highway Cable Guard which protects the sides of the road. American Welded Wire Fabric which lengthens the life of the pavement . . . keeps it smooth, easy-riding, and safe. And American Road Joints which smooth the transition from slab to slab.

These are essential materials for any truly modern highway. Use them in your roads . . . in your city streets.

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IN THE PAVEMENT. A smooth pavement is a *safer* pavement, and American Welded Wire Fabric and American Road Joints help assure years of smooth, safe riding on great highways such as the Ohio Turnpike, the Pennsylvania Turnpike, the Indiana Toll Road, and others.

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Cleveland 13, Ohio

Please send complete information on the following products:

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USS American Welded Wire Fabric

UNITED STATES STEEL

Before you buy any giant-sized

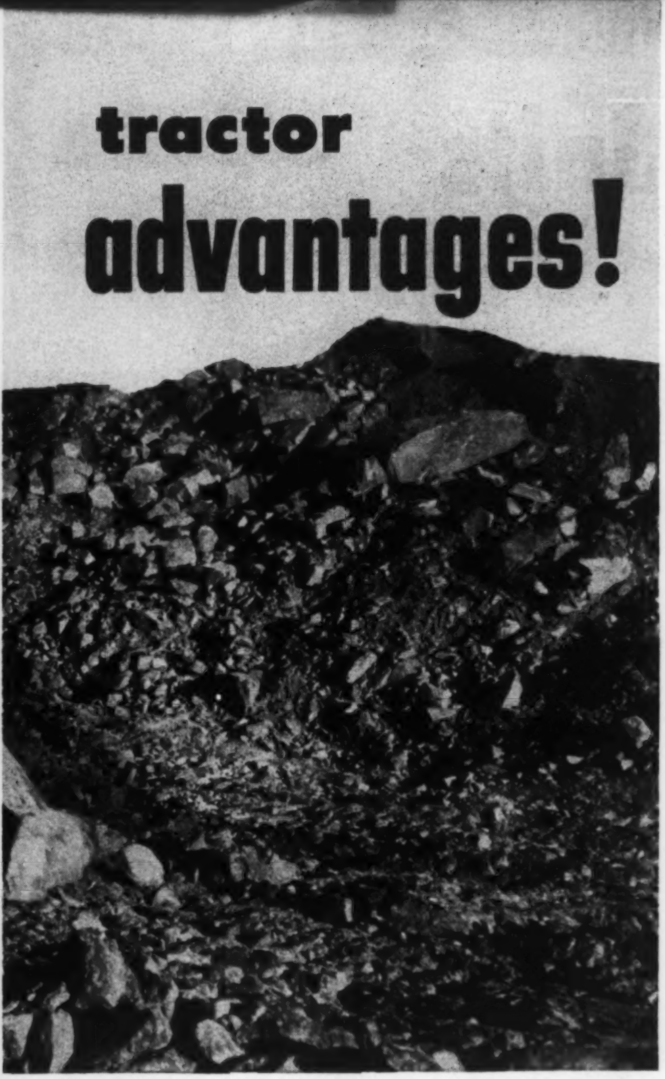
Measure TD-24 giant-sized

When you're 'dozing through rock and other materials, instant fingertip Hi-Lo shifting is a big cycle-speeder. And it cuts operator effort way down!

With full-time "live" power on both tracks, the TD-24 almost builds the road itself—hugging the mountain slope, giving added *operating ease, safety, and capacity!* That's another bonus from exclusive time-proven Planet-Power steering.

Try holding a 19-ton load on the blade with any other crawler this big—making a turn as this TD-24 is doing with both tracks pulling, while stockpiling coal with a special wing-type blade. The TD-24's operator can make "round-house," feathered, or pivot turns—with fingertip ease!

tractor advantages!



When you buy a big crawler look beyond sheer size and weight. You may be paying for enough extra "iron" to cause a startling jump in fuel and upkeep costs. So compare. Weigh bigness against provable working and earning capacity! Measure these giant-sized TD-24 advantages that have proven out over 8 years of on-the-job success!

Eliminates "dead-track drag!"

Does the giant you're considering steer with full-time "live" power and "live" traction on both tracks? TD-24 users by the thousands have proved that any crawler *this big* is obsolete without exclusive, time-proved Planet-Power steering advantages!

Planet-Power steering eliminates power-wasting, load-limiting "dead-track drag." Upgrade, downgrade, or on the level, you can smoothly turn a heavily-loaded TD-24—under positive control!

Does the big one you're looking at give cycle-speeding on-the-go shifting? The TD-24 does! And the exclusive two-speed planetary system teamed with a 4 speed synchromesh transmission —gives instant, stall-preventing and time-gaining Hi-Lo shifting, *without declutching.*

Does that big one you need have the genuine in-seat, seconds-fast, all-weather International gasoline conversion starting? Or the operating ease, power-transfer efficiency, and service-simplicity of the International Cerametallic-faced engine clutch? Or 8 practical speeds *forward and reverse?* Only the TD-24 has all these, plus dozens of other giant-sized advantages!

Prove to yourself the TD-24 beats all other giant-sized power—for *performance value*—for *big-scale ability to make you big money.* Ask your International Construction Equipment Distributor for a demonstration of a Gear-Drive or Torque-Converter TD-24!

INTERNATIONAL® CONSTRUCTION EQUIPMENT

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Side-Boom Tractors ... Self-Propelled Scrapers and Bottom-Dumps ... Crawler and Rubber-Tired Loaders ... Off-Highway Trucks ... Diesel and Carbureted Engines ... Motor Trucks

Heap-loading the sideboarded International "75" Payscraper in less than a minute proves the economy and efficiency of the TD-24 as a "pusher."

INTERNATIONAL
PAYSCRAPER

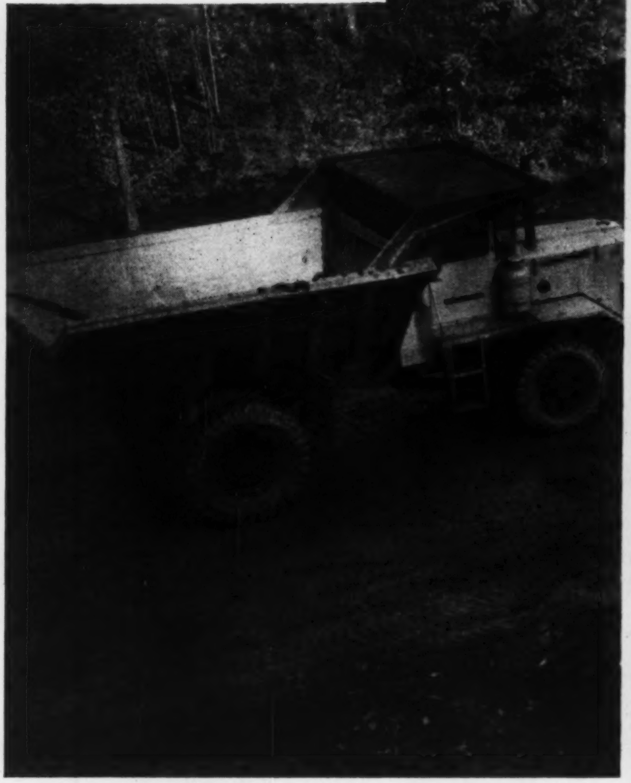
3 Payhauler® Units *match 4 competitive rigs* on "W.Va.'s most dangerous road job!"

Earn 25% equipment saving ...33% production gain for Acme Construction Company, Bluefield, West Virginia

In the mountain-rugged, rough and rocky country of southern West Virginia, three International "65" Payhauler trucks are doing the work of four similar competitive units...on the same job...under the same tough conditions. The location is Welch, where Acme Construction Company of Bluefield, is moving 100,000 cubic yards of rocky material "clover-leafing" U. S. Bypass Route 52...labeled by Jim Chase, superintendent, as "West Virginia's most dangerous road job."

All haul units on the job are in the same capacity and power class. They're all loaded by a 1½ cu yd shovel...they all travel the same ½-mile to the fill and the same return route. Yet, the Payhauler trucks because of their ample, turbo-charged diesel power, plus load-matched gear ratios, smooth the get-away —and permit quick shifting into time-gaining, hill-climbing higher gear! This performance under rough and rugged conditions has caused Jim Chase to say, "We get the same production from 3 International '65' Payhaulers as we do with our four other units...a 25% savings in equipment, a 33% gain in production."

Prove to yourself how much an International "65" or "95" Payhauler will boost your off-highway hauling capacity. Try its safe and easy full-load maneuverability. Test the power-transfer efficiency of its long-lasting Cerametallic-faced clutch. Ask your International Construction Equipment distributor for a demonstration!



International TD-24 dozes shot-rock down the slope to 1½ cu yd shovel and easy-loading International "65" Payhauler. 250,000 pounds of dynamite were used...about a pound to every 3 yds of rock!

INTERNATIONAL® CONSTRUCTION EQUIPMENT

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A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Side-Boom Tractors ... Self-Propelled Scrapers and Bottom-Dumps ... Crawler and Rubber-Tired Loaders ... Off-Highway Trucks ... Diesel and Carbureted Engines ... Motor Trucks

↓ Ample power from a 250 hp Turbo-charged engine drives the model "65" at production-boosting speeds...with fuel consumption savings of 10% or more. Ten-speed transmission gives right gear for every grade...every road condition.

↓ Double acting hoist cylinder in all stages with *106,300 pounds of force in first stage* permits dumping heaped loads in less than 10 seconds. Hydraulic snubbing action prevents undue stress on hoist cylinders and "gentles" body return to frame.

↑ Strongest frame in its class and big 10 x 14 foot high tensile steel Payhauler body permit faster, more carefree loading of rock or other tough materials. Model "65" Payhauler body gives you big, profit-boosting, 18-ton capacity, model "95" a husky 24 tons.

New Speed Record in Baltimore for Erection of Structural Steel

Steelwork erected at the rate of 300 tons per week—that's the record set for Baltimore recently during the construction of the Commercial Credit Building, attractive new home office for Commercial Credit Corporation. The 4,850-ton framework for the 20-story structure was erected in just over sixteen weeks, using Bethlehem High-Strength Bolts as connectors for the structural members.

Bethlehem High-Strength Bolts save time in erecting steelwork because they can be installed quickly by two men, one using a holding wrench, the other a calibrated impact wrench. Each bolt is used with two hardened washers, one placed under the head, the other under the nut. The joints thus obtained are tight and sound.

High-strength bolting also has other advantages. It is relatively free from noise, making it a desirable form of construction for hospital and school areas. What's more, there are no fire hazards to contend with, as the bolts are installed cold.

Bethlehem High-Strength Bolts are made of carbon steel in popular sizes, and are quenched and tempered to meet the requirements of ASTM Specification A-325. Their use is explained fully in our 24-page booklet on high-strength bolting. If you would like to have a copy for reference, just drop a line to the nearest Bethlehem sales office.

Using Bethlehem High-Strength Bolts, Bethlehem ironworkers erected 4,850 tons of steelwork for Commercial Credit Building in just over sixteen weeks, setting new speed record for steel erection in Baltimore. *Architects:* Harrison & Abramovitz, New York; *Structural Engineer:* Edwards & Hjorth, New York; *General Contractor:* Consolidated Engineering Co., Inc., Baltimore.

COLOR MOVIE ON BOLT-MAKING

The entire story of the manufacture of fasteners is told in our interesting color film, "Holding Power." 16 mm, with sound. Showing time, 25 minutes. If you would like to have a print for showing, please write to us at Bethlehem, Pa.

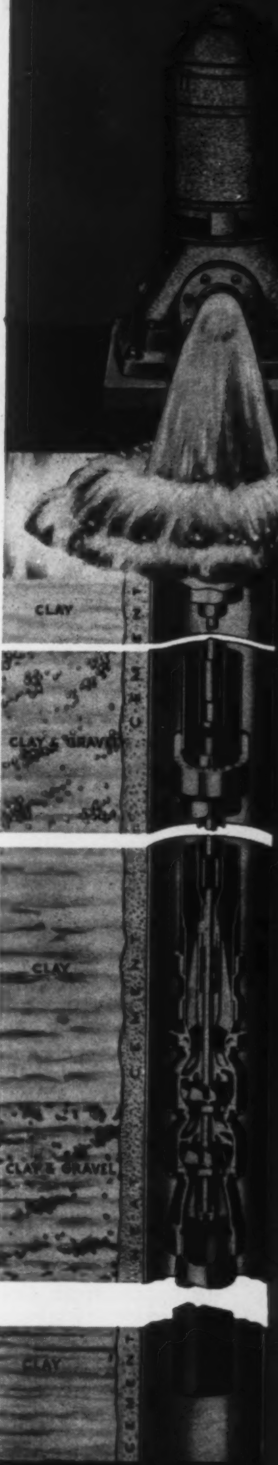
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Deep in the Earth There's Another Reason Layne's on Top!



THE LAYNE IMPELLER is that reason, because a pump can be no better than its impeller.

There are two main considerations in impeller evaluation—QUALITY AND PERFORMANCE.

QUALITY—The materials used in the manufacture of a Layne impeller must be tough, durable and possess excellent *surface quality* and they must be able to insure *dimensional accuracy.* Metal patterns are used in casting high quality phosphor gear bronze into Layne impellers. Other special metals are specificed when necessary.

PERFORMANCE—A Layne impeller is correct in hydraulic design based on 75 years of Layne experience through thousands of successful installations and tests. Correct impeller design determines a pump's performance in any particular hydraulic condition.

Each Layne impeller is precision manufactured. Because no one technique is adequate, both hand finishing and special machining are used in balancing and tooling the impeller. Working to a rigid and minimum tolerance, specially designed gauges and instruments check each step to the finish of a Layne impeller . . . from water passages and angles to vane thickness.

Layne Impeller sizes range from 4" diameter and up, as specified.

The result — an impeller which operates deep in the recesses of the earth dynamically in balance. Each remaining component part of a Layne pump receives the same careful engineered attention, and when assembled assures complete pump perfection giving you years of trouble-free service.

Layne's 75 years of experience puts Layne on top!

1882 — 1957
Layne
75 YEARS OF PROGRESS

WATER WELLS • VERTICAL TURBINE PUMPS • WATER TREATMENT

LAYNE & BOWLER, INC. MEMPHIS

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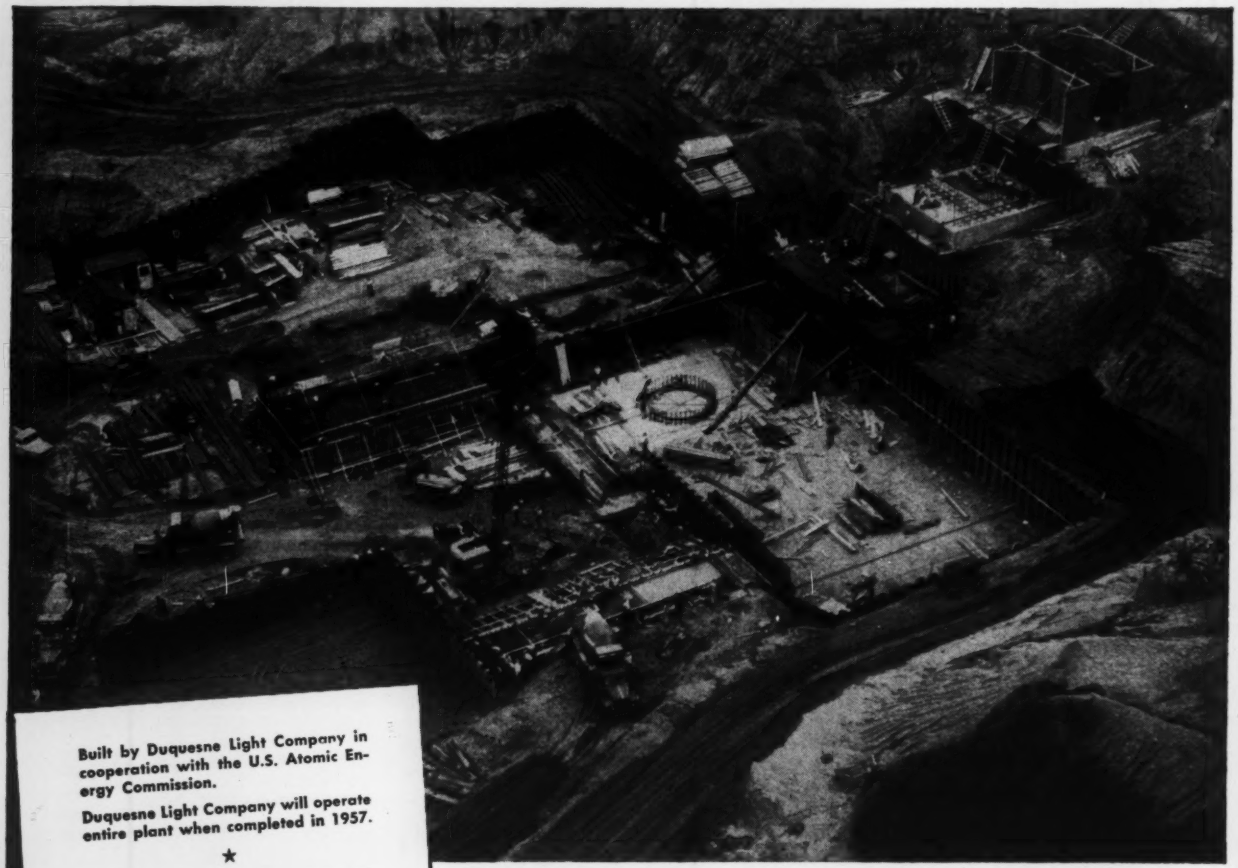
LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

At Nation's First Full-Scale Atomic Energy

700 TONS OF USS STEEL

provide permanent retaining



Built by Duquesne Light Company in cooperation with the U.S. Atomic Energy Commission.

Duquesne Light Company will operate entire plant when completed in 1957.

★

Westinghouse Electric Corp., under contract with the Atomic Energy Commission, is building the reactor.

★

Burns and Roe, Inc. is the agent-constructor for Duquesne Light Co. Associates are J. Rich Steers, Inc., and Hatzel and Buehler, Inc.

★

Ferguson & Edmundson Company is sub-contractor for Excavation and Piling.

★

Stone and Webster Engineering Corporation is Architect-Engineer for Westinghouse.

Electric Power Plant—

SHEET PILING

wall for main structure of big project!

THE LARGE PICTURE at the left shows the foundation construction for the nation's first full-scale nuclear power plant.

Being built by Duquesne Light Company in cooperation with the Atomic Energy Commission, the huge project is located at Shippingport, Pa.—on the Ohio River about 25 miles below Pittsburgh.

This revolutionary plant, which will have a nuclear reactor producing at least 60,000-kw net electrical output, as well as a turbine-generator capable of 100,000-kw, will deliver electricity to Duquesne's customers in Allegheny and Beaver Counties.

Because the main structure will extend 75 ft. below grade, 23,896 lineal feet of USS sheet piling were driven to an average depth of 36 feet into the ground for the necessary retaining wall prior to the extensive excavating.

The approximately 700 tons of sheet piling not only served as the outside form for the pouring of the reinforced concrete walls, but were left in the ground permanently as a strong, durable steel skin for the concrete—*a double wall, so to speak.*

The application of USS Steel Sheet Piling at Shippingport is further proof that this versatile construction medium is the ideal solution to any problem involving the retention and control of earth or water. Forming a continuous wall, interlocking USS Sheet Piling offers easily installed construction that is strong, rugged and lasting.

For detailed information about this economical steel piling which is available in straight-web, arch-web, and Z-sections, contact the nearest office, or write to our Pittsburgh headquarters.

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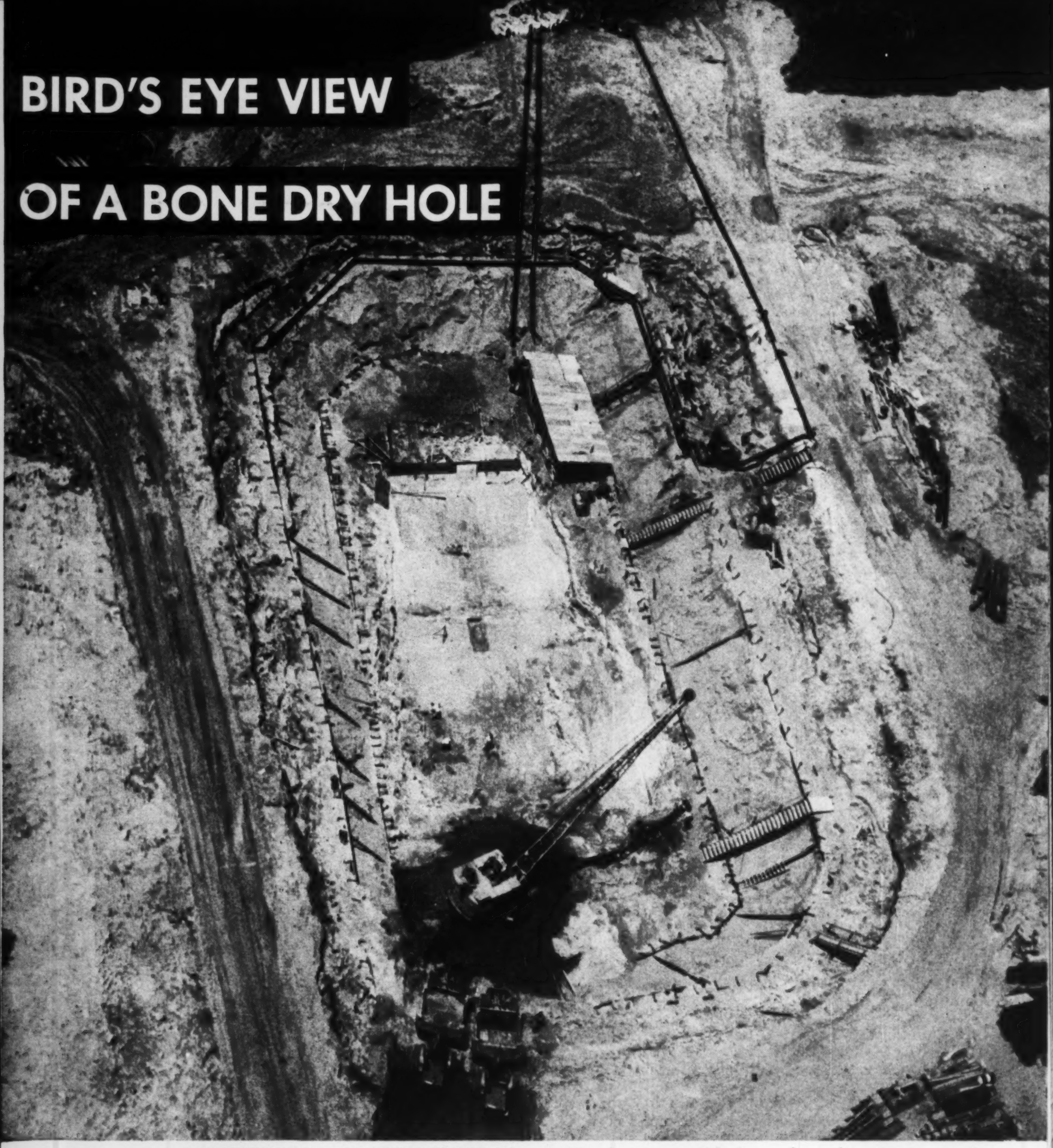
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL



BIRD'S EYE VIEW OF A BONE DRY HOLE

Two-stage MORETRENCH WELLPOINT SYSTEM keeps 38′ of water well below subgrade on pump station in Sayreville, New Jersey. Material — fine to coarse sand and clay. For expert pumping — *at a saving* — get Moretrench on your job! For full details, call our nearest office.

Contractor: Wallace J. Wilck, Inc., Perth Amboy, N. J.
Owner: Middlesex County Sewerage Authority, New Jersey.
Engineer: Bogert & Childs, New York.

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STEEL FORMS PROVE FAR SUPERIOR TO WOOD FORMS FOR CONCRETING ST. LAWRENCE SEAWAY PROJECTS

BLAW-KNOX time and labor-saving STEEL FORMS surpass 12-month wood forms yardage in one summer season!

TWO concreting methods used on the St. Lawrence Seaway Project's Barnhart Island Power Dam showed significant differences between the use of steel forms and wood forms. Working a 12-month season on half of the dam, the contractor using wood forms was well ahead of the contractor responsible for the other half in yardage placed by the spring of '56. Last May, starting a "summer-season" schedule, B. Perini & Sons, Inc. utilized the speed and labor-saving advantages of Blaw-Knox Steel Forms to catch up with *and surpass* the wood forms users in concrete poured before the onset of cold weather last fall.

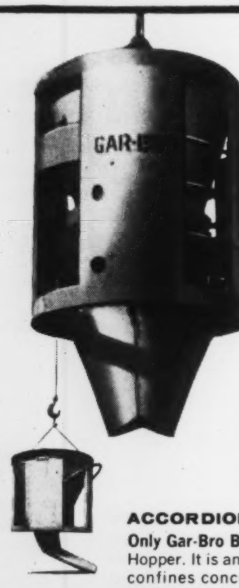
Here are a few of the reasons why Blaw-Knox Steel Forms have proved to be far superior on the Barnhart Island Power Dam:

- Steel forms mean speed! Perini could get one complete use of each set of steel forms every 3 weeks, as compared to a possible 7-week cycle on the wood forms.
- Piers, walls, roofs and the rear elbows of draft tubes can be formed and poured in low lifts. Forms can be moved quickly along from unit to unit of the dam, in a fast cycle of re-use.
- Designed specifically by experienced Blaw-Knox engineers for the exact configurations and construction joints of this structure, the steel forms saved the time and labor of building wood forms to fit each pouring phase.

Blaw-Knox Steel Forms engineers are backed by over 40 years' practical experience in solving concreting problems on dozens of big projects such as Chief Joseph Dam and The Dalles project, as well as many of the other lock and dam structures of the St. Lawrence Seaway. *You can put that experience to work for you.* Whether your job is a big dam, tunnel, bridge, or small sewer, be sure to call in the Blaw-Knox Steel Forms Consultation Service in the preliminary planning stage for the simplified, fast forming that increases your profits by reducing time and labor costs.

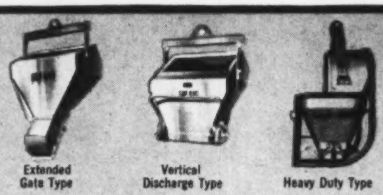
BLAW-KNOX COMPANY
STEEL FORMS DEPARTMENT • BLAW-KNOX EQUIPMENT DIVISION
P. O. BOX 1198 • PITTSBURGH, PA. • PHONE STERLING 1-2700

BLAW-KNOX STEEL FORMS CONSULTATION SERVICE

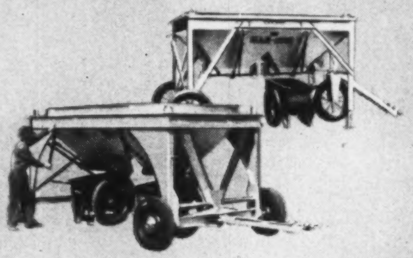


ROUND CONCRETE BUCKETS
Select from 17 models of Gar-Bro Buckets ranging from 1/3 to 8 cu. yds. There are types for handling any concrete from normal slump to the driest low slump. All have Gar-Bro patented, self-closing, double clamshell gates—they are non-jamming and grout tight. Large buckets have air-operated gates with pull chain or remote control.

ACCORDION RUBBER HOPPERS (Patented)
Only Gar-Bro Buckets can be equipped with an Accordion Hopper. It is an exclusive patented bucket attachment that confines concrete when pouring into narrow forms. It fastens directly to gate and opens and closes with the gate.

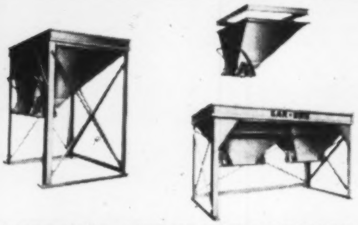


LAYDOWN BUCKETS
They lay down and roll over to a low loading height and automatically resume a vertical position when lifted. 16 standard models ranging from 1/2 to 3 cu. yds. of three types to suit any job.



PORTABLE HOPPERS
6 Models with three types of mountings are available in the Gar-Bro line. They save truck mixer waiting time and prevent delay of the cart crew and finishers. Have low (70" to 75") loading height and 36" clearance for cart loading.

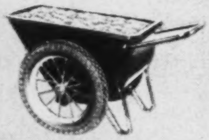
Only GAR-BRO offers
A COMPLETE SELECTION
of concrete handling equipment



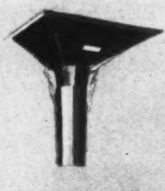
RECEIVING AND FLOOR HOPPERS
16 Hopper Units with capacities from 1 to 5.3 cu. yds. are convertible from a Receiving Hopper to a Floor Hopper by use of leg stands. Both vertical front and center discharge type are available in single or double gate types.

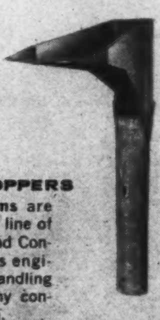
ONLY GAR-BRO SPECIALIZES in concrete handling equipment. And only Gar-Bro has a complete line of more than 300 equipment items to give you a complete selection of types and sizes to suit your concrete placing job. Gar-Bro's 30 years of experience makes a big difference in the ease of operation . . . in the efficiency . . . and in the extra advantages of Gar-Bro equipment for concrete handling—there is no substitute.

GAR-BRO MANUFACTURING CO. Los Angeles, Calif. • Peoria, Ill.
GENERAL OFFICES: 2415 E. Washington Blvd., Los Angeles 21, California

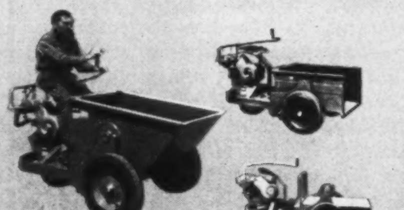


CONCRETE CARTS
All carts are not the same. Gar-Bro Carts are "balanced" — when loaded . . . easier to handle . . . easier to push. 3 sizes: narrow and standard 6 and also 8 cu. ft., rocker dumps.





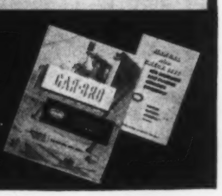
COLLECTION HOPPERS
A Choice of 87 Items are available in Gar-Bro's line of Collection Hoppers and Concrete Chutes. Each is engineered by concrete handling experts to answer any concrete placing problem.

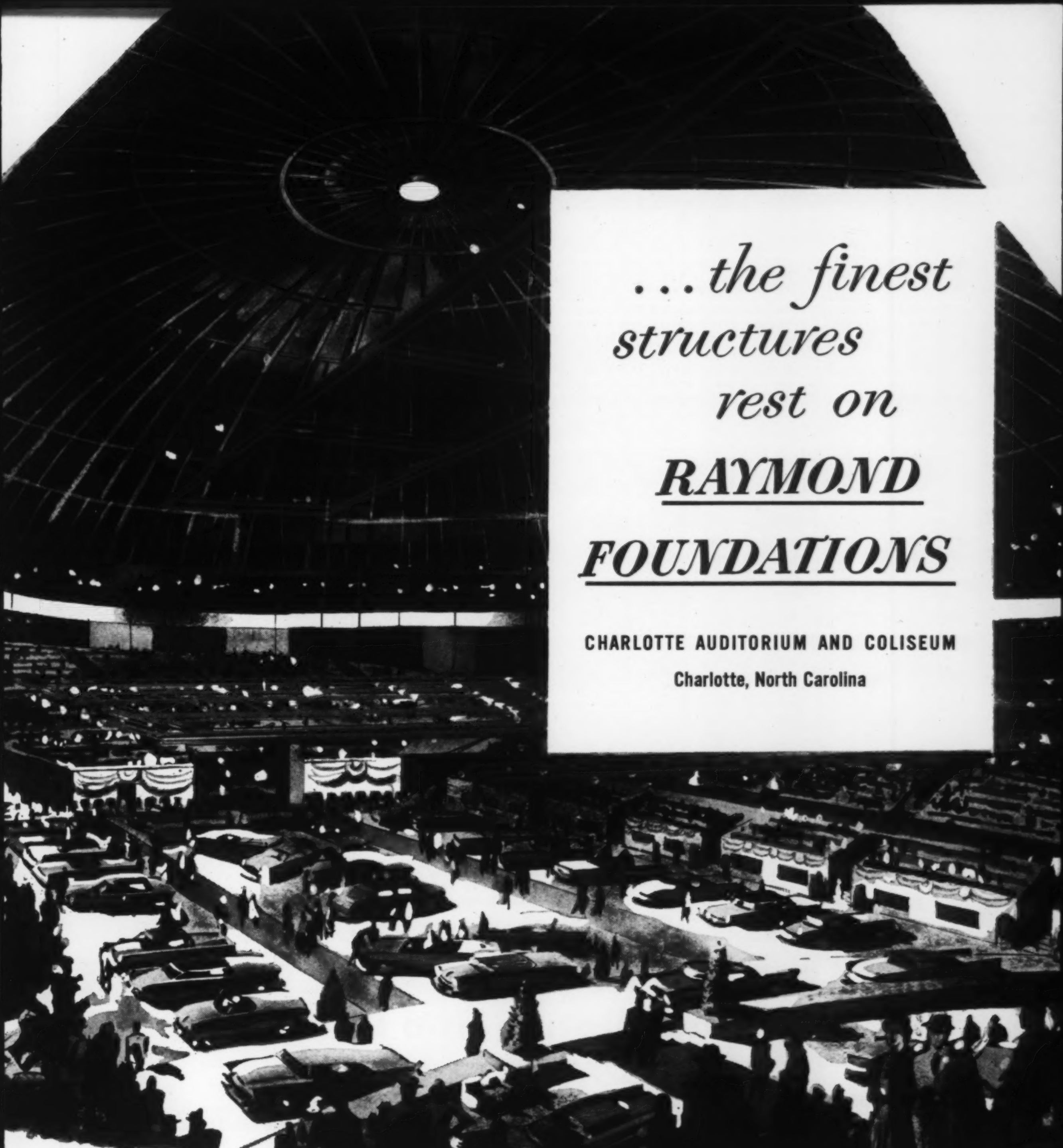


POWER-CART
Designed for Concrete Handling and for faster, safer operation on temporary runways. Handles 12 cu. ft. . . . turns in 4' radius . . . controls dumping . . . operates on 2 gal. of gas per day. Light and fast either forward or reverse.

Designed with concrete in mind . . .
GAR-BRO
The world's most complete line of **CONCRETE HANDLING EQUIPMENT**

Write for catalog and Concrete Handling Manual.





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Charlotte, North Carolina

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STRUCTURAL ENGINEERS: Severud-Elstad-Krueger
ARCHITECTS: A. G. Odell, Jr. & Associates

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COMPLETE CONSTRUCTION SERVICES ABROAD

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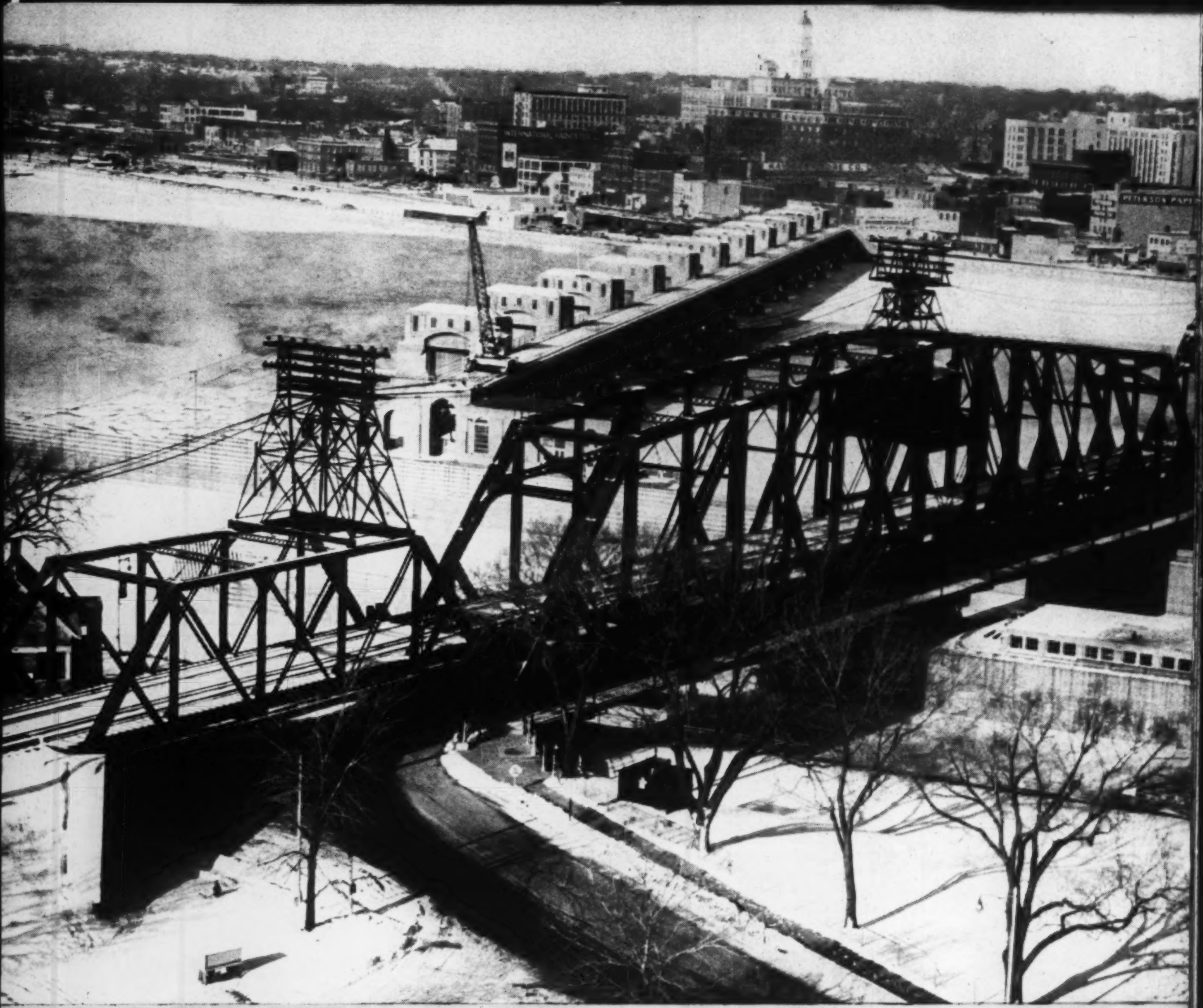
CONCRETE PILE CO.
OUR 60th YEAR 140 Cedar Street • New York 6, N. Y.
Branch Offices in principal cities of the United States, Canada, Central and South America.

You are cordially invited to send for our new Highway Brochure, which gives a detailed resume of how Raymond can help you and the National Highway Program. Just write Dept. C-3, Raymond Concrete Pile Co., 140 Cedar Street, N. Y. 6, N. Y.



New GREULICH 4-way GRID

Holds Installation and Handling Costs to

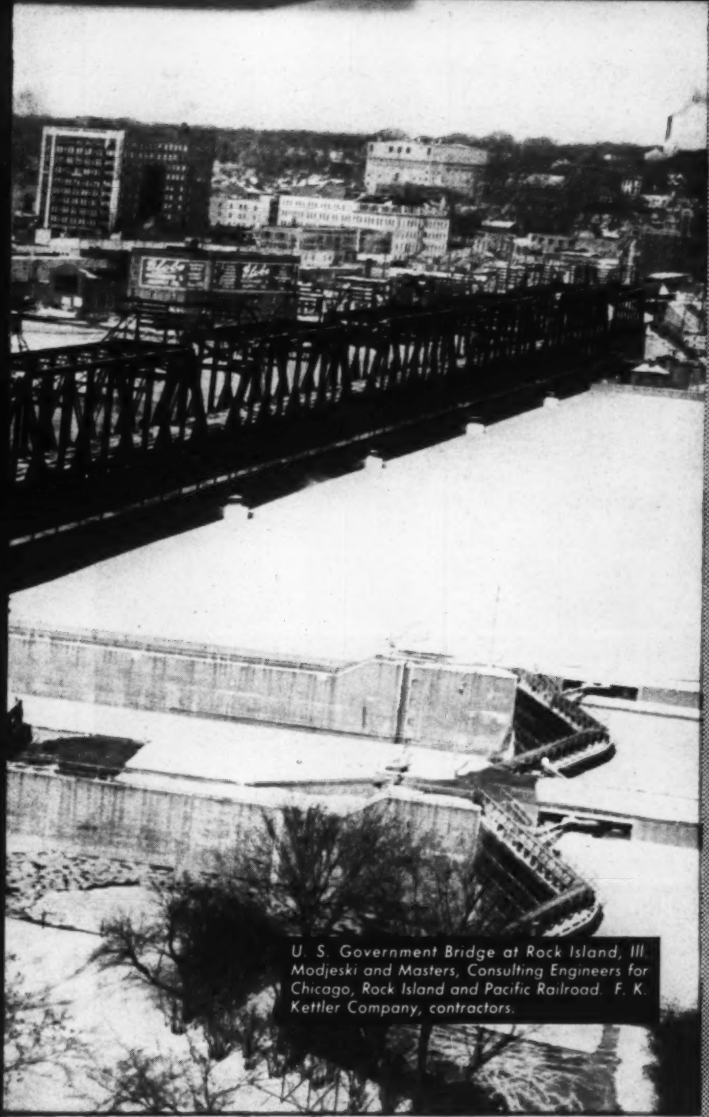
Kerrigan Bridge Flooring was the choice of the F. K. Kettler Company, contractors for the job of modernizing the famous double-deck Rock Island Bridge which spans the Mississippi from Rock Island, Ill. to Davenport, Iowa (just ½ mile downstream from the original bridge built in 1855-56 and defended by Abraham Lincoln in the trial which established for all time the right of a railroad to bridge a navigable stream.).

The Greulich 4-way grid design, with integrally connected triangles, provides a flat, single plane serrated surface extending over the entire roadway to insure maximum lateral or horizontal rigidity and high skid resistance.

Precision manufactured in solid, 5-inch deep units, the 4-way grids come out square and rigid; remain true during shipment, handling, and erection. This effects true alignment. *Test data is available.*

The Greulich design also provides economy in field erection—*with no loss of strength!* Bearing members are spaced 7½ inches apart instead of 6 inches (cutting field welds by 20%); and units are fabricated in panels 7 feet, 3 inches wide—a size which cuts handling costs to a minimum but still permits hauling on ordinary flat bed trucks. Panels can be fabricated in lengths up to 36 feet.

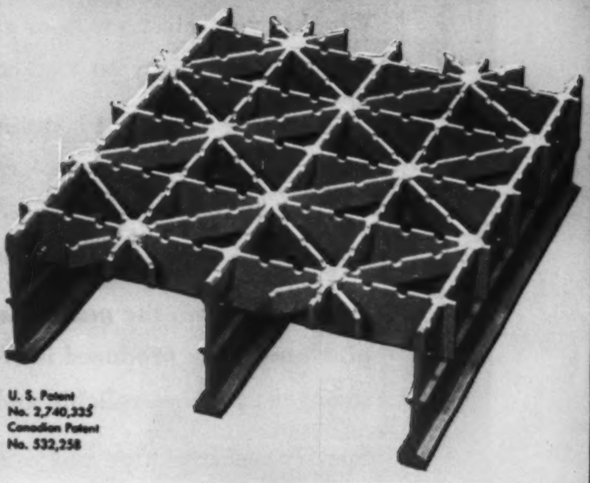
GENERAL SALES OFFICE 274 MADISON AVE., NEW YORK, N. Y.



U. S. Government Bridge at Rock Island, Ill. Modjeski and Masters, Consulting Engineers for Chicago, Rock Island and Pacific Railroad. F. K. Kettler Company, contractors.

Lanier Bridge, Gainesville, Georgia —see left, below, for over-all view

from KERRIGAN a Minimum



U. S. Patent No. 2,740,335 Canadian Patent No. 532,258

4-WAY GRID OPEN STEEL BRIDGE FLOORING

- **STRONGER**
- **QUIETER**
- **20% FEWER WELDS**

For additional information, test data, and list of bridges in Ga., La., Fla., Mass., Ill., Md., Minn., and Penn. you can inspect write Harvey F. Neel, Mgr., Div. G-4, Kerrigan Iron Works, Inc., Nashville, Tennessee.

THE FORGES OF KERRIGAN

KERRIGAN IRON WORKS, Inc.

BRIDGE FLOORING DIVISION (Harvey F. Neel, Mgr.), NASHVILLE, TENN.

You can stake your

River crossing of cast iron pipe line to carry sewage to disposal plant at Portland, Oregon.

Cast iron pipe for large automobile assembly plant in New Jersey.

Whether you select a man or a product, you judge dependability on the record.

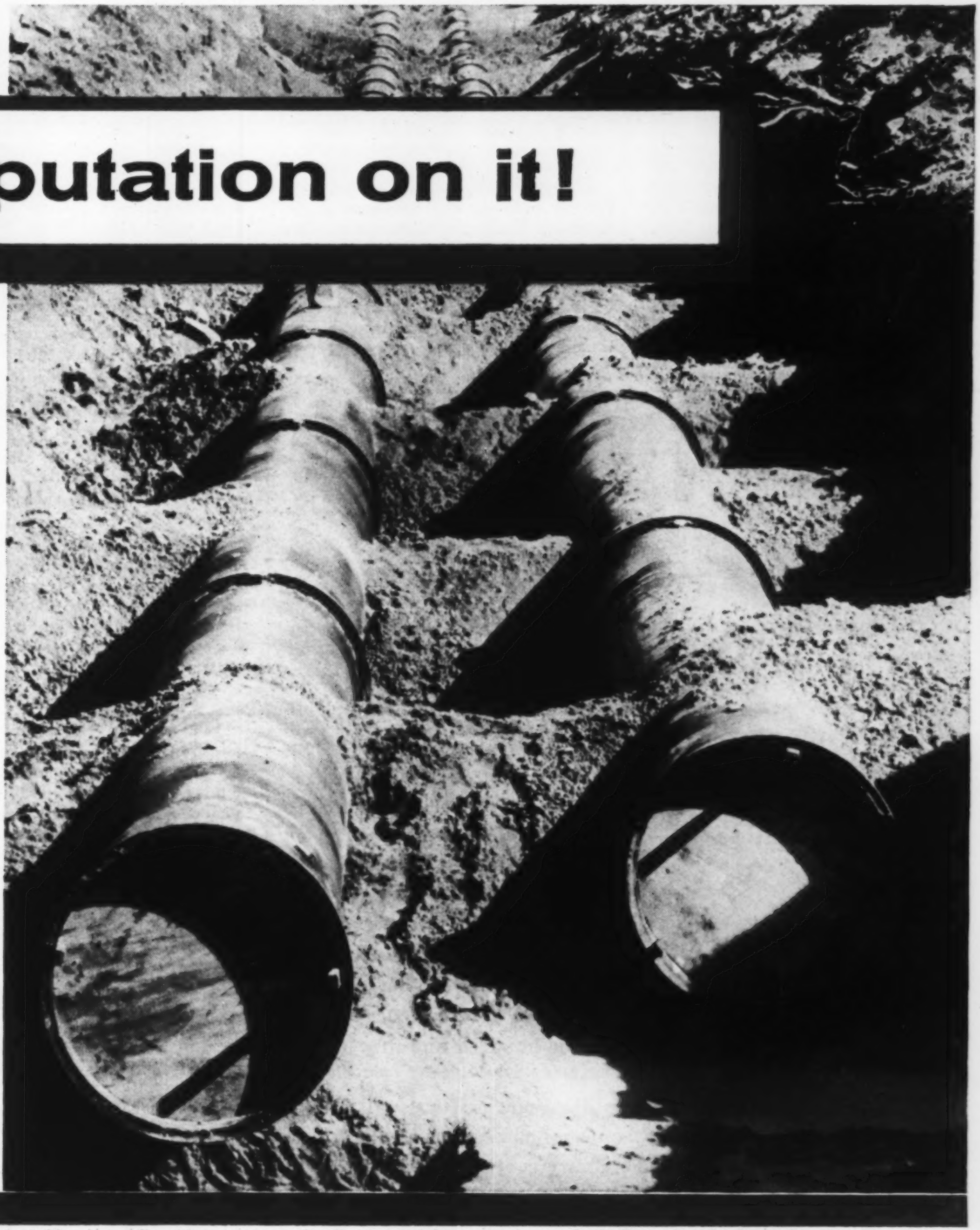
Cast iron pipe's record is unmatched. Proof? Today nearly seventy cities are still using cast iron mains that have been in continuous use for a hundred years and more!

More important, the *modernized* cast iron pipe now being produced is even tougher, stronger . . . more reliable and efficient.

Specify cast iron pipe and you assure the long life, dependability and economy that protect *your* reputation.

CAST IRON PIPE

reputation on it!



Installing large diameter cast iron pipe lines supplying water to synthetic fibre plant in South Carolina.

CAST IRON ®

For further information write: Cast Iron Pipe Research Association,
Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3.

SERVES FOR CENTURIES...

NEWS OF ENGINEERS

William T. Bryant has been named a field superintendent in the Allis-Chalmers service section at Milwaukee, Wis., where he will handle the erection of cement equipment. Mr. Bryant is a civil engineering graduate of Virginia Military Institute and recently completed the Allis-Chalmers training course for graduate engineers.

Thomas R. Glenn, Jr., has been appointed assistant chief engineer of the Interstate Sanitation Commission, New York City. Mr. Glenn was formerly in the civil engineering department at Rutgers University, where he taught both graduate and undergraduate courses in sanitary engineering and short courses to water works and sewage treatment plant operators. The commission operates under a tri-state compact entered into by New York, New Jersey, and Connecticut for pollution abatement.

150 YEARS OF PUBLISHING 1807 1957

LOOKING FORWARD

Robert Fulton's marvelous steamboat fired the minds of forward-looking men when she churned up the Hudson in 1807.

To the House of Wiley, founded that same year, the *Clermont's* voyage opened up a new and exciting frontier in publishing.

If America were to exploit her new industrial age, pioneering books would have to be provided. It is this demand — greater in 1957 than ever — that Wiley has been meeting successfully for one hundred and fifty years.

Today, the *Clermont's* atom-powered granddaughter slips through the seas . . . the scientific community continues to expand . . . and, planning for the future,

John Wiley & Sons looks forward to publishing an ever-greater number of distinguished books in all areas of pure and applied science.

JOHN WILEY & SONS, Inc.
440 Fourth Avenue, New York 16, N. Y.

Edwin R. Albertson and **Charles T. Walsh** have been admitted to partnership in Bowe, Albertson & Associates, engineers of New York City. Mr. Albertson formerly held the position of chief engineer and Mr. Walsh, of engineering assistant. **Kenneth D. Allen** has become an associate member in the firm.

Arthur G. Van Reuth and **Roland W. Weidner** announce their association for the practice of civil engineering and land surveying under the firm name, Van Reuth and Weidner, Inc., with offices at 811 East Belvedere Avenue, Baltimore 12, Md.

Whitney C. Huntington retired as head of the department of civil engineering at the University of Illinois on September 1. He went to the Illinois faculty in 1926 from the University of Colorado, from which he was graduated in 1910. He was on the staff at Colorado from 1911 to 1926 and was head of the department of civil engineering from 1919 to 1926. For two years Professor Huntington was chairman of the Engineering Advisory Board of the Civil Works Administration of Illinois. He is the author of two text books, *Building Construction* and *Earth Pressures* and *Retaining Walls*.

W. C. Huntington

Frank A. Butrico has succeeded **Harvey F. Ludwig** (December issue, page 27) as chief of the Office of Engineering Resources, Division of Sanitary Engineering Services, U. S. Public Health Service, Washington, D. C. Mr. Butrico entered the Public Health Service in 1944, and at the time of his recent promotion was sanitary engineer director and assistant chief.

John H. Melvin, state geologist of Ohio from 1947 until recently, has been elected vice-president of operations of the Pennsylvania Drilling Co., Pittsburgh, Pa.

Joseph D. Lewin

Joseph D. Lewin, consulting engineer, formerly associated with N. A. Lougee & Co., of New York, has been appointed assistant to the president of the DeLong Corporation of the same city. In his new capacity Mr. Lewin recently made an extensive survey trip to the Near and Middle East areas where he inspected many public work and industrial projects. He is also continuing his services as confidential consultant to the Greek Government. Mr. Lewin is active in the ASCE Power Division and author of numerous papers in the field.

Ladislas Segoe & Associates, city planners and consulting engineers, announce the expansion and relocation of their offices. They are now at 811 Gwynne Building, Cincinnati 2, Ohio.

August W. Noack, Jr., Emil Kordish and **Burton N. Cox, Jr.,** associates in the engineering firm of Rummel, Klepper & Kahl of Baltimore, Md., were recently admitted to partnership in the firm.

Stanley H. Fistedis has accepted a position as engineer in the Reactor Engineering Division of the Argonne National Laboratory at Lemont, Ill. He was formerly with the Girdler Company, of Louisville, Ky., as staff engineer on special assignments.

Lowell O. Stewart, professor and head of the civil engineering department at Iowa State College, Ames, Iowa, was honored as "Engineer of the Month" by the *Central Constructor* (Iowa construction news). Professor Stewart joined the faculty of Iowa State College in 1924, becoming head of the civil engineering department in 1938. He has been a guiding influence in the Iowa Section for 16 years and has served as secretary-treasurer for a number of years.

Clyde D. Gessel, hydraulic engineer with the U. S. Bureau of Reclamation at Salt Lake City, Utah, was elected chairman of the Utah Engineering Council during the group's recent annual meeting in Salt Lake City.

B. P. McWhorter, regional engineer for the U. S. Bureau of Public Roads at Atlanta, Ga., retired from the Bureau on January 31. Mr. McWhorter will continue to reside in Decatur, Ga., and serve in a consulting capacity in the states of Florida and Georgia.

Thomas C. Hanson, partner in the Detroit civil engineering firm of Mason L. Brown & Son since 1949, has been named vice-chairman of the civil engineering department at the University of Detroit. From 1947 to 1949 Mr. Hanson was commissioner of the Detroit Department of Public Works and the Department of Street Railways. He is a past-president of the Michigan Section.

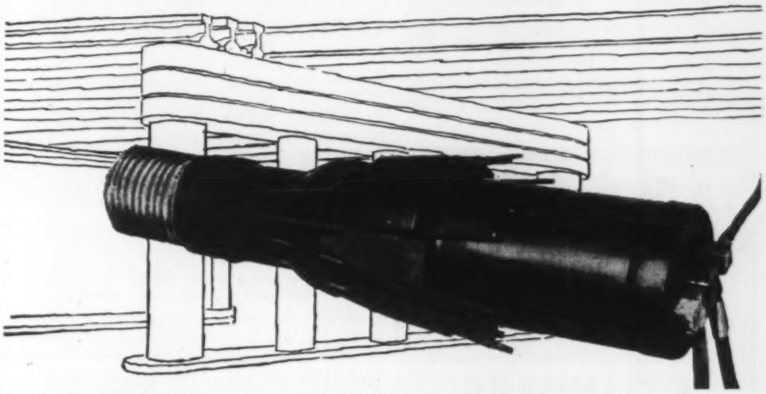
Theodore F. Collier has been made vice-president of Westcott and Mapes, Inc., of New Haven, Conn. Mr. Collier has been in charge of the Civil-Structural Engineering Division of the firm since his association with it in 1950. Since June 1954 Mr. Collier has also been project engineer for the joint office of Westcott & Mapes, Inc., and Seelye, Stevenson, Value & Knecht, a New York City engineering firm. This joint office, located at Branford, Conn., has handled the engineering for part of the Connecticut Turnpike.

Donald H. Herak, for the past four years Spokane district engineer for the Portland Cement Association, has resigned to accept the post of manager of the Acme Concrete Co. in Spokane.

(Continued on page 26)

CONTRACTORS

—are you getting your share of PRESTRESSED BRIDGE JOBS?



Here's good news for contractors bidding on the ever-increasing number of prestressed concrete bridge jobs throughout the country! From a single supplier—The Intercontinental Equipment Co., Inc.—now you can get the full line of Freyssinet-engineered material and equipment for prestressing. This means top quality, competitive pricing, and immediate delivery of products developed by the most famous name in its field.

Here are the basic units you'll need for your next prestressed bridge job:

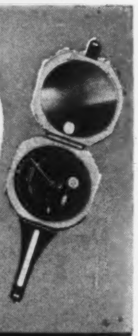
ANCHORAGE UNITS
CABLE ASSEMBLIES
TENSIONING JACKS
HYDRAULIC PUMP
GROUT MIXER
GROUT PUMP

With these products available, every contractor can bid on any prestressed structure with convenience and assurance of lower cost.

So, for full details and a free copy of your products catalogue, write, wire, or telephone now to

INTERCONTINENTAL EQUIPMENT CO., INC.
Prestressed Concrete Division
120 Broadway, New York 5, N. Y.

Member Prestressed Concrete Institute



For
CIVIL
ENGINEERS

THE BRUNTON* POCKET TRANSIT

IT'S HANDY...
weighs only 9 oz.; 2¾" x 3" x 1⅛"; easy to carry in pocket, on belt, in car.

IT'S VERSATILE...
ideal for preliminary and supplementary surveying; used as a compass, transit, level, plumb, alidade, clinometer.

IT'S MADE TO LAST A LIFETIME
Shows direction to 1°; level, slope or grade within 1°.

"Over 60,000 Brunton Transits since 1896"

See your local engineering supply house or WRITE FOR CATALOG

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WM. AINSWORTH & SONS, INC.
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CYLINDERS
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If it's a concrete tester you need—get in touch with

FORNEY'S, Inc.
TESTER DIVISION
P. O. BOX 310 - NEW CASTLE, PA.

News of Engineers

(Continued from page 25)

D. J. Bleifuss, L. A. Hostetter, and **N. L. Hinkson** have established a consulting engineering practice under the firm name of Bleifuss, Hostetter & Associates, with offices at 5350 H Street, Sacramento, Calif. The associates in the new firm are **G. H. Kippel, J. A. Langbein, R. W. Rollins, J. V. Williamson, K. B. Mayo, T. P. Wootton,** and **G. J. Johnson.**

Carlos D. Bullock has joined the Topeka, Kans., consulting firm of Burgwin & Martin as chief of the Structural and Bridge Design Section. For the past seven years. Mr. Bullock has been regional structural engineer for the Portland Cement Association with headquarters in Kansas City, and for eight years prior to that was district structural engineer at Philadelphia. At one time he was associate engineer for the Tennessee Valley Authority on the Guntersville Project.

Carlos D. Bullock

E. W. Southworth has been named resident manager of the new Tampa, Fla., engineering office of Gibbs & Hill, Inc., New York consulting engineers. Mr. Southworth was formerly in the New York office.

Joseph D. Blatt has assumed the duties of deputy regional administrator of the Civil Aeronautics Administration with headquarters at New York International Airport. Mr. Blatt joined the CAA in 1937, and has held assignments in various parts of the country, most recently as head of planning, research and development activities in Washington.

Radnor J. Paquette, professor of civil engineering at Georgia Institute of Technology, has been elected president of the Education Division of the American Road Builders Association. The election took place at the ARBA's recent annual meeting in Chicago.

S. R. Webb has been promoted to vice-president of engineering in the Carolina Steel and Iron Co. at Greensboro, N. C. Mr. Webb formerly held the position of chief engineer.

Wentworth R. Lovering has been named to succeed **Fred N. Finn** as district engineer for the Asphalt Institute at Sacramento, Calif. Mr. Lovering, a 28-year veteran of the California Division of Highways, takes over the duties relinquished by Mr. Finn when the latter was assigned to the $14 million AASHO Test Road Project now under construction in Illinois.

Robert S. Holmes has been appointed highway construction representative in the market development division of the United States Steel Corp., Pittsburgh. In this newly created position Mr. Holmes will correlate the combined efforts and interests of the corporation and its various divisions in support of the thirteen-year Federal Highway Program. Before going to U. S. Steel he was executive assistant to the president of Wald Industries.

J. Edward Martin, partner and chief of engineering for Albert C. Martin and Associates of Los Angeles, was honored recently at a testimonial luncheon at the Los Angeles Athletic Club tendered him by architectural and building industry leaders. Mr. Martin, whose firm was the first to design more than 1,000,000 square feet of lift-slab construction, received an Award of Recognition presented by the Vagtborg Lift-Slab Corp.

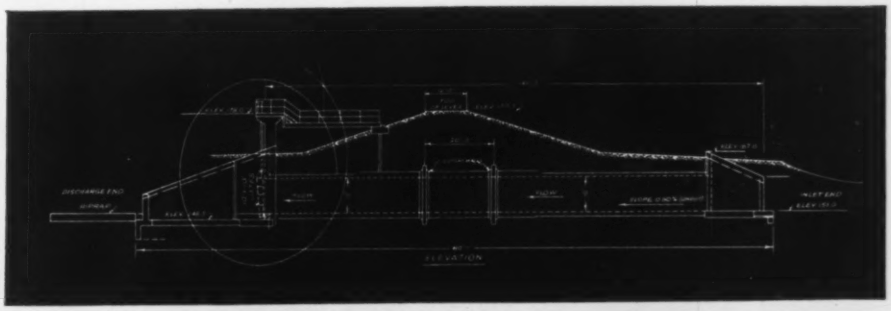
Peter J. Reidy, president of Purdy & Henderson Associates, Inc., of New York City, was recently elected president of the New York Association of Consulting Engineers. He took office January 1.

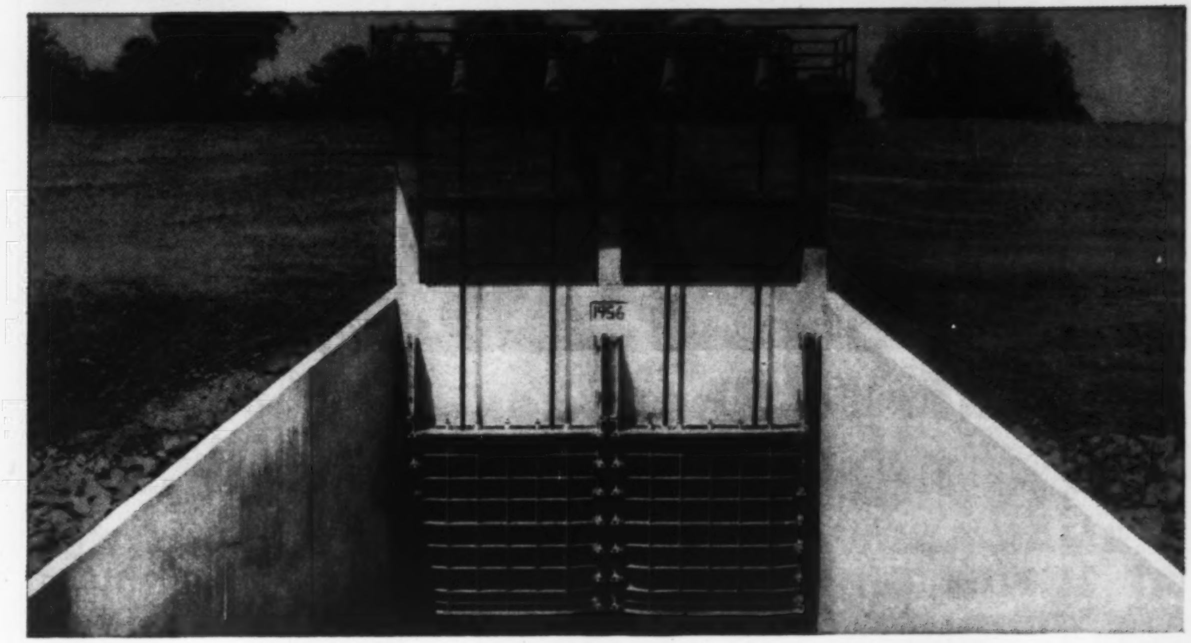
Daniel Gotthelf has been appointed to the headquarters staff of ASCE as Assistant Editor of Technical Publications. Mr. Gotthelf received his degree in civil engineering in June 1956 from the Cooper Union School of Engineering, where he was editor of a department newspaper, associate editor of Chi Epsilon, and an active member of the ASCE Student Chapter. He was awarded a prize in the 1956 student-paper contest, sponsored by the Cooper Union Alumni Association, for his paper, "Area Development for Large and Small Lots." He has been an instructor in surveying at Cooper Union and was recently engaged in highway work for the consulting firm of Goodkind and O'Dea, of Bloomfield, N. J., and Hamden, Conn.

Daniel Gotthelf

John C. B. Elliott, retired Brigadier General, U.S.A.F., has returned to the Bryan, Tex., offices of Spencer J. Buchanan and Associates, consulting engineers, following a brief period in Eng-

(Continued on page 120)





Makes the Bayou behave

Water control engineering problems are unique in their profound effect upon human lives, health and prosperity.

In this installation, Rodney Hunt engineering and sluice gate design protect more than 80 square miles of farm land. The gates, when open, allow normal drainage to the Bayou River, and when closed prevent flooding as the river goes to flood stage.

The two Rodney Hunt 10-foot by 10-foot cast iron bronze-mounted sluice gates were designed for maximum opening with minimum structure. The installation is unique because inherently rigid flange frame sluice gates with wall thimbles were installed with attaching studs projecting to the front of the frame. This eliminated the need for excessive side clearance and saved on structural costs. Rodney Hunt also supplied precision-built interconnecting floor stands with twin stems on each gate for balanced, smooth operation.

Projects of such importance demand skilled engineering as well as unquestioned product dependability.

RODNEY HUNT MACHINE CO.
Water Control Equipment Division
86 Lake Street, Orange, Massachusetts, U.S.A.

RODNEY HUNT ®

SERVING WATER CONTROL ENGINEERS WITH SLUICE GATES AND ENGINEERING

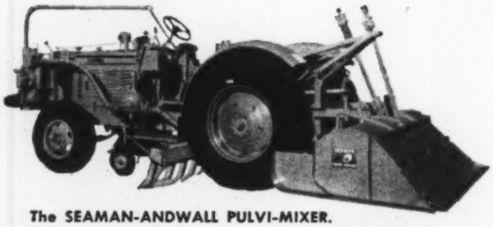
Shoulder to Shoulder—
and on Shoulders, too

SEAMAN-ANDWALL PROVIDES HIGHER DENSITIES AT LOWER BUDGETS

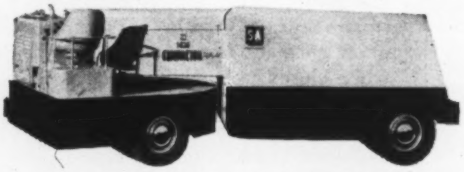
The SEAMAN-ANDWALL Pulvi-Mixer and the Self-Propelled 7-20 Ton Pneumatic Compactor are perfect partners in achieving high density stabilizations. Whether the job be of native soils, soil-cement, bituminous binder or chemical additives the Pulvi-Mixer provides a basic mix that rolls out to the tightest, highest load-bearing, weather resistant base or sub-base. When the Pulvi-Mixer completes its work the mix remains shaped to final grade and crown ready for immediate compaction. No finish blading is needed.

The Pneumatic Compactor . . . Adjustable to any weight between 7 and 20 tons, the Compactor retains the ideal placement and arrangement of coarse and fines which the Pulvi-Mixer established. Because power is applied to the front rolls only presure is "straight down" so there is no displacement of materials, no scuffing and no surface shear.

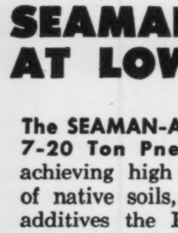
Most maneuverable of all the heavyweights the COMPACTOR turns 180° on a 21 foot road. The operator sits sideways to forward travel, a position in which he has complete visibility of the rolling operation and best control for close-up work. Self-propelled, it is quickly moved from job to job under its own power.



The SEAMAN-ANDWALL PULVI-MIXER.
7 ft. mixing width, gasoline or diesel powered.



The SEAMAN-ANDWALL Self Propelled 7-20 Ton Pneumatic Compactor.



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. . . . . Am-Soc Briefs

▶ ▶ When is surveying civil engineering and when not? That is the knotty problem being studied by a committee of the Surveying and Mapping Division. The effects of the results of this study could be far reaching. Whether you are primarily engaged in the practice of surveying or not, the interim report (page 71) makes interesting reading.

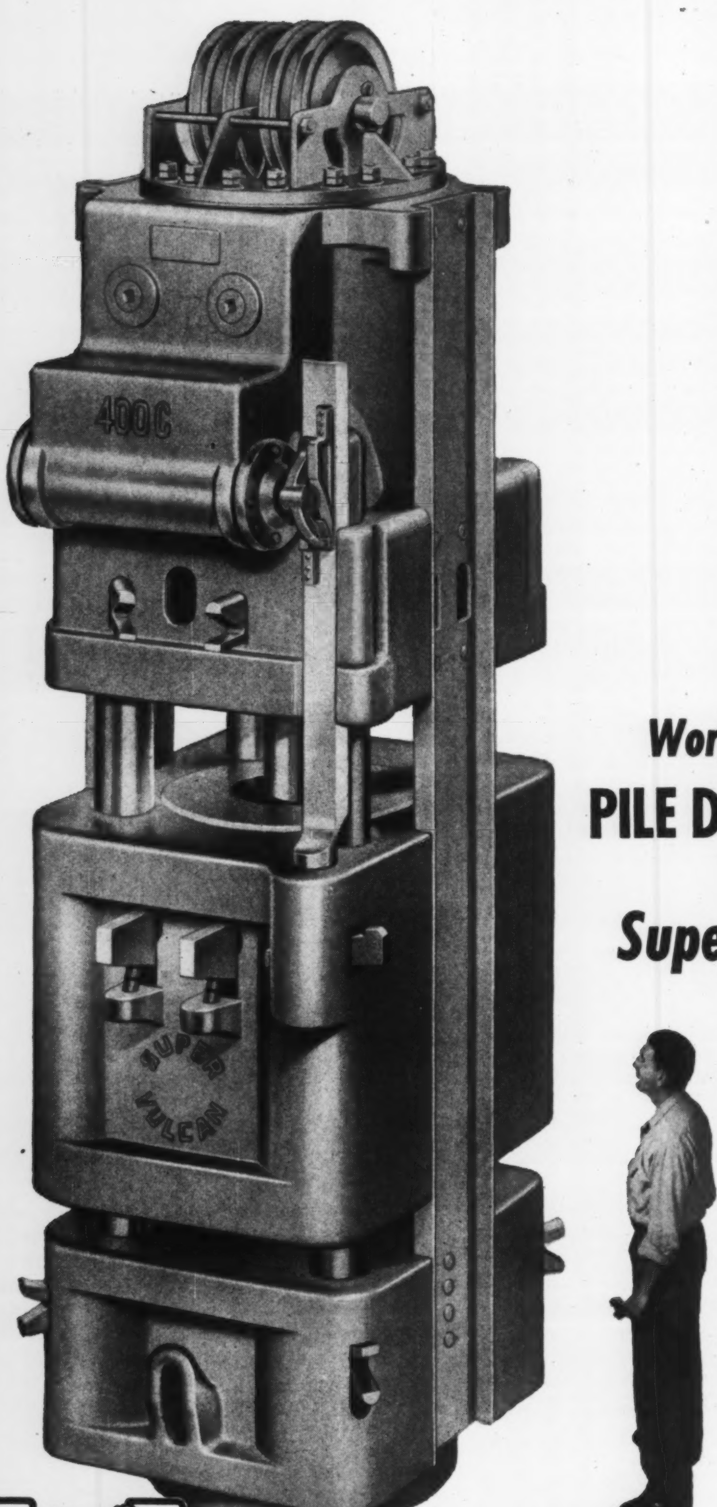
▶ ▶ Junior Member applications for transfer to higher grade for the months of December and January were triple the number for the same months a year ago. Transfers from Associate Member to Member during same period were double last year's figures.

▶ ▶ ASCE members played a significant role at the recent Third General Assembly of EJC. Two of three general sessions were moderated by prominent AM-Soc members. See report on page 69. Copies of EJC's report, "Professional Income of Engineers—1956" are now available for $1.50. Requests should be directed to Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

▶ ▶ First Journal of the Pipeline Division will appear this month (March), the second is slated for June. An intensive membership drive is on, seeking participation of all engineers engaged in pipeline work in the work of the Division. Interested? Contact your Local Section officers or Society headquarters directly.

▶ ▶ Those members shuffling off to Buffalo this coming June will not want for field trips. In addition to the mammoth Seaway and Power Project construction, trips are planned to Bethlehem's Buffalo Plant, sixth largest in the world in terms of production, the Canadian Sir Adam Beck Hydro Station, the Huntley Steam Station with an installed capacity of 1,200,000 kw, New York State Thruway construction, and for the romantic set a trip to Niagara Falls.

▶ ▶ The new United Engineering Center will have C. E. Davies, Executive Secretary of ASME, as coordinator. . . . Terms under which the AIChE is to be admitted to United Engineering Trustees have been agreed upon by all concerned. Details are now being negotiated. . . . Costs for rehabilitating the present site for the new Center have been found to be excessive, and steps are being taken to find a new site in a prestige area.



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do you know that

Vision and imagination cannot be legislated? So says Federal Administrator Bertram D. Tallamy who analyzes problems involved in carrying out the new highway program in the leading article in this issue. Among potential "roadblocks," as Mr. Tallamy sees it, are the varying state laws governing the acquisition of rights-of-way and the absence in many states of provision for a continuing source of revenue to match federal funds.

• • •

When all factors are weighed, the new highways are not expensive? That is, they are cheap in comparison to what inadequate roads have already cost us in human lives. In a stimulating discussion of the "bargains" available to today's contractors (page 36), R. D. Evans underscores the "folly of driving six times as many automobiles twice as fast and ten times as far as our present road system was designed to carry in the 1920's."

• • •

In due course it will actually be possible to drive from coast to coast without stopping for a light? This is one of the benefits of the Federal Highway Program enumerated by interim Administrator John A. Volpe. In the meantime, for motorists so minded, nonstop travel from the East Coast to the Mississippi is a more immediate possibility, with most of the east-west Illinois Turnpike currently under contract. Opening of the final 16-mile Chicago link of the Indiana Turnpike in November brought New York and Chicago within one day's motoring range of each other.

• • •

A car radio device may be used to relieve traffic jams? An automatic radio warning system to talk motorists out of traffic jams was demonstrated at a recent meeting of the American Association of State Highway Officials. Similar to the device used to guide pilots into airports, the new development is essentially a form of induction radio that would provide information to drivers only without interfering with commercial broadcasts. The device, which was developed by the Telecarrier Corporation, may ultimately be installed as standard equipment in cars.

• • •

Progress is being made against highway fund diversion? In 1956 two more victories in the battle against highway fund diversion were chalked up, with Louisiana and Montana passing constitutional amendments earmarking highway user tax revenues for highway purposes. This makes eleven states that have taken such action since the end of the war and brings to twenty-seven the number that now have protection for their road-tax funds. Source for these figures is the November-December issue of "The Tax Economics Bulletin."

• • •

Adequate salaries alone will not induce young engineers to enter the highway field? To man our highway departments effectively, according to C. E. Fritts, vice-president of engineering for the Automotive Safety Foundation, careers in the field must not be subject to the political whims of management. This can be brought about, he said, by good systems of Civil Service or merit ratings. He also advocated higher salaries (initial and for advanced positions) and better retirement provision.

• • •

Photogrammetric methods of computing earthwork quantities have been adopted by several states? Pennsylvania has already paid for earthwork established by photogrammetry, and Ohio and Massachusetts have contracted for earthwork on that basis. This is one of the methods adopted to speed the highway program, which are reported by Archie Carter in the current article, "The Contractor Takes the Highway Program in His Stride."

• • •

Despite spiraling costs of labor and materials, it is still cheaper to move a yard of earth than it was twenty-five years ago? That was one of the big points made at this year's ARBA Road Show, where 300 exhibitors displayed more than $12,000,000 worth of today's fabulous equipment to 55,000 engineers, contractors, and public officials. Road Show developments are reported on page 42.

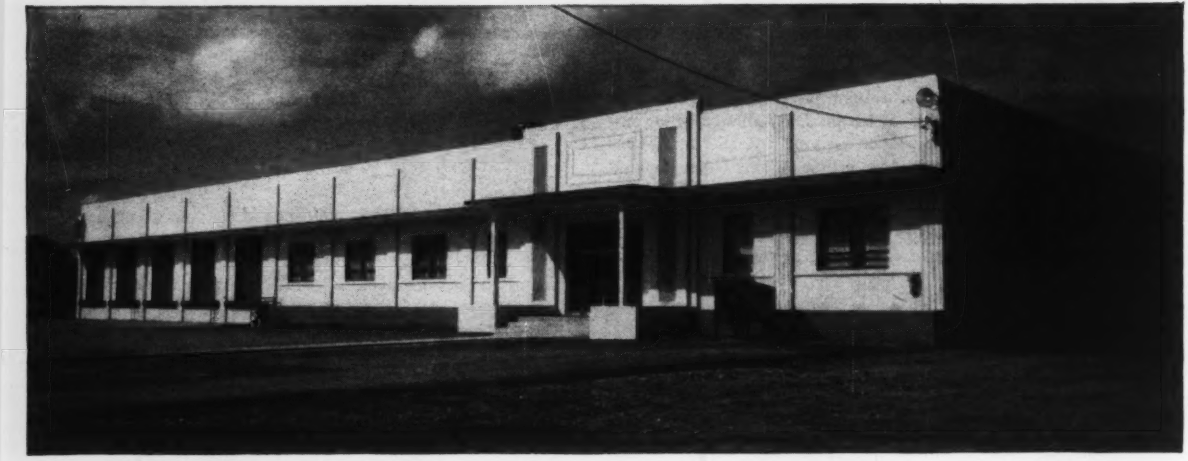
• • •

One electronic computer, with allied equipment, can serve all the needs of a highway department spending $300,000,000 for right-of-way and construction? This is the belief of the California Division of Highways, which is using computers to speed up calculations for traverse, earthwork, and bridge design. The Division expects that the computer will eventually pick up 10 to 20 percent of the total load of the Bridge Design Section. An article by Highway Division engineers is scheduled for April.

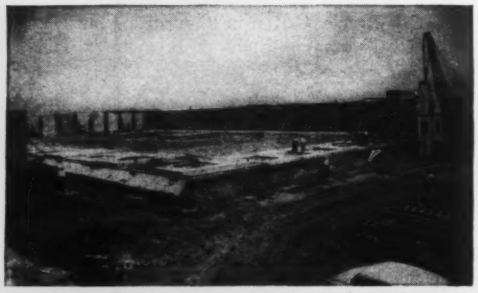
• • •

Miami is enlarging its sewerage facilities? Expansion of mushrooming Miami's treatment system is covered by two of the engineers on the project in two forthcoming issues, the first scheduled for April. Philadelphia's Torresdale Filter Plant is the subject of another timely April paper.

Talk About VALUE



Precast, Prestressed 'Incor' Concrete Structural Members in Place for 68¢ per Sq. Ft., in This Prefabricated Concrete Warehouse



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The best is yet to come . . .

Highways are at the front and center of the construction stage this year and will be for several years to come—as anyone who has spent more than five minutes reading the engineering journals must know. The boxcar figures that are being quoted stagger the imagination. It is difficult to find enough engineers, materials, and equipment to accomplish the task. And yet this is not all that lies ahead for the civil engineering profession.

The impact of the road program on the nation should be as great as, if not greater than, the railroad boom of the late nineteenth century. With 40,000 more miles of first-class arterial highways and countless more miles of feeder roads, the entire structure of place economy will change. Industry can move from overcrowded urban areas and still have fast, dependable transportation to markets or shipping points. As industries move, new population centers will grow up around them. Construction of homes, water supply and sewerage systems, new schools, churches, and commercial developments must necessarily follow. Such a pattern of development is not pure crystal-ball gazing. In a limited way this very thing has happened around the major freeways and toll roads that have already been built. In short, the road building program is only the beginning.

It is not to be assumed that everyone concerned with engineering and construction will be riding in gold Cadillacs from here on. While construction spending is high in some areas, there will be some segments of the industry in which activity will be relatively low. As time goes on, emphasis will shift from one type of construction to another. For instance, home building money is tight today. But over the years the impact of the road building program will be felt throughout the construction industry. With the proper combination of foresight and sound engineering management, we should be facing many years of vigorous engineering activity. We can measure up to the task, but our sights must be set high.

THE GRAND CHALLENGE

BERTRAM D. TALLAMY, M. ASCE

Federal Highway Administrator,

Washington, D. C.

Several months have now passed since the enactment of the most imaginative and progressive highway program in history. Approval by the 84th Congress and President Eisenhower of the Federal-Aid Highway Act of 1956 set in motion financial and other machinery for filling our critical highway needs within a 13- or 15-year period.

The program involves the expenditure during those years of some $50,000,000,000 on new roads, including 41,000 miles of Interstate routes linking nearly all of our principal cities. The big new program has been greeted widely and warmly as a "grand plan" for catching up with our highway backlog and providing for the traffic requirements of 1975.

It is a grand plan, indeed, and one which stands as a tribute to the President, the Congress, and the many organizations and individuals who carried on a long fight to meet the highway crisis realistically and with bold vision. Now a solution is in sight but this is no time for relaxation. Keeping the program on schedule presents a momentous challenge to the Federal Government as well as to the state highway departments, the contractors, the suppliers of materials, and all types of individuals and organizations involved in the final result.

In the first six months after passage of the Federal-Aid Highway Act, more funds were allotted to projects by the Federal Government than in any previous full year in history. During that period work was started on highway projects totaling more than $1,300,000,000. On the Interstate System alone, contracts aggregating $286,000,000 had been awarded for nearly 500 miles of these basic and urgently needed routes. In a statement before the Subcommittee on Roads of the Senate Committee on Public Works on January 7, Secretary of Commerce Sinclair Weeks said:

"This spectacular increase in our rate of contracts advertised and funds obligated is not just a sudden spurt, and there is every reason to believe that the present rate of progress will be maintained and further increased in future months. If we continue only at the same rate for the balance of the current fiscal year, an amount equivalent to all of the fiscal year 1957 authorization of Interstate funds will be committed to approved plans and right-of-way acquisitions by June 30, 1957. This will be the first time in history that funds in an amount equivalent to the total authorized for any particular fiscal year have actually been obligated for plan approvals during the fiscal year then current. As of today six states not only have committed all of their 1957 Interstate funds, but have begun working into those apportioned for the 1958 fiscal year."

This is an optimistic view and one with which I entirely agree. **Wherein, then, lies the challenge?** It lies in many directions but, first of all, it is important to remember that the states are now advancing to contract many plans which had been gathering dust for months or years for lack of financing. This backlog will soon reach the vanishing point and the efficiency and ingenuity of the state highway departments will be severely taxed to produce an even flow of plans and designs so that the federal highway program can proceed on schedule and without interruption. Such a continuous flow will be absolutely essential if the program is to be accomplished within the contemplated 13- or 15-year period. By the same token, the program would be of greatly diminished value if it were 90 percent completed within the prescribed time but there were gaps in vital sections of the Interstate System.

Everyone is painfully aware of the shortage of engineers and the difficulty of luring those now available and the new graduates into public service. I won't dwell on that problem beyond holding out the hope that more efficient deployment of the engineering personnel in the highway departments, plus the use of aerial surveying techniques and electronic computers, may stretch the available forces immeasurably. Too many trained engineers spend too much of their time at routine jobs which could be handled by clerks or by the electronic devices now becoming available.

A further knotty problem presents itself in the availability of steel, cement, asphalt, sand, gravel, stone, and the hundreds of other construction materials. Allied with this is the capacity of the contracting organizations to undertake and complete such a gigantic construction program in a relatively short time. Other potential roadblocks are the varying state laws governing the acquisition of rights-of-way and the absence in many states of provision for a continuing source of revenue to match federal funds.

None of these problems is insurmountable; all can be overcome by hard work, ingenuity, advance planning or a combination of these, starting at the top and filtering down to the rodman in a survey crew. I have been designated to administer this vast program within the framework of policy formulated by the legislation and the Department of Commerce. Fortunately, the Commissioner and personnel of the Bureau of Public Roads are men of long experience and keen insight in highway matters. The Bureau's Washington headquarters, its 11 regional offices, and various district offices throughout the country have a king-size job for the next 13 or 15 years at least.

The 41,000-mile National System of Interstate and Defense Highways is the most glamorous and widely publicized feature of the new program. It is natural that this should be so since it will cost $27.4 million in federal and state funds and will provide a nation-wide network of ultramodern superhighways. It will link all 48 states and nearly all of our cities of more than 50,000 population. It is the backbone of our highway transportation system.

Yet no single system, however vital, can stand alone. Under the Federal-Aid Highway Act of 1956, some 741,824 miles of road systems are eligible for federal aid. The primary system totals 234,148 miles, including the Interstate and urban network. The system of secondary or farm-to-market roads comprises 507,676 miles serving the transportation needs of rural areas not served by the primary system. If the Interstate System is to realize its full potential to the economy and to national defense, it is vital that all the feeder and auxiliary systems be improved and maintained to adequate standards.

Possibly **the greatest challenge of all** posed by the new highway program is the challenge to the vision and imagination of the state highway engineers and their staffs. What kind of roads will we have 15 years from now? Will they be adequate to serve 100,000,000 vehicles and 225,000,000 people? Will they foster economic growth and development and at the same time fill their role as defense arteries? The answer lies, initially at least, in the state highway departments. While the federal act prescribes minimum standards for the Interstate System, I expect that the departments will not be content with a mere passing grade in design.

I have said before that practical vision and imagination can't be legislated and I think it's worth saying again. Minimum standards are just that, and should not be treated as a guide in highway design and construction. I might clarify my meaning by pointing to the New York Thruway, which has been referred to as a model for the design of the Interstate System. We initially adopted a 20-ft minimum center dividing strip to separate the opposing Thruway lanes. Yet we adhered to this only where economics or considerations of property disruption dictated it. Over most of the route the center mall ranges from 44 ft to 800 ft or more in width, depending upon the value of the land and topography. On the newer sections an 80-ft minimum was established for the medial strip and it widens out to 1,000 ft in many areas. The main point is that a varying width of center mall relieves monotony, adds interest to the trip, and makes for a safe highway.

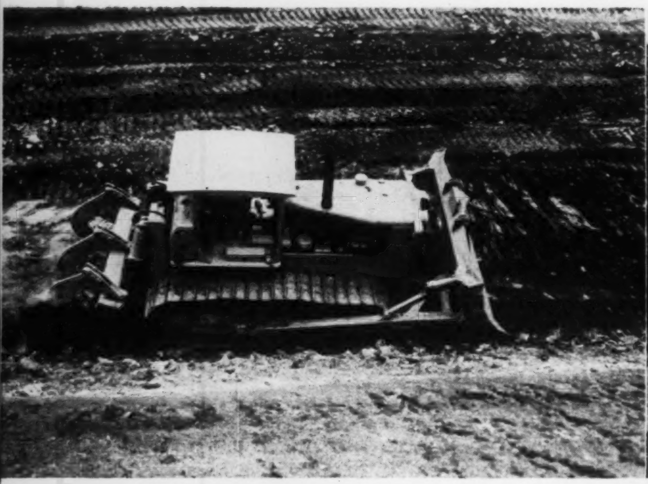
Likewise it frequently costs no more to run the opposing traffic lanes at differing elevations and otherwise take advantage of natural topography. Proper design of a highway requires a mixture of psychology, imagination, and technical know-how. If any one of these is lacking, the end result is monotony or danger or both.

Likewise it is the worst kind of short-sightedness to route a new road too close to an existing highway or a railroad unless absolutely essential. This of course has the effect of creating a "no man's land" between the two facilities and stifles proper land use along either.

Modern, planned-access highways not only cut the traffic fatality rate in half, they exert a profoundly beneficial effect on the economy. It is gratifying to me, as it must be to any thinking person, that we have now come to grips with the highway problem and initiated bold action to overcome our deficiencies within a reasonable period.

From here on in it's a matter of production. Every day's delay in reaching the final goal exacts a tremendous toll in dollars, lives, and human misery. Let's all get on with the job.

A BARGAIN IN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Today track-type tractor has grown up, added new muscles, and taken on new jobs. Here (1), Caterpillar D9 tractor, equipped with No. 9S bulldozer and No. 9 ripper, is working on relocation of U. S. 220 near Sproul, Penn. Wheeled equipment has come into wide use. Maintenance of roads to and from Vaquero Dam site, northeast of Santa Maria, Calif., is job of the Catepillar No. 12 motor grader, seen in (2). Motor graders have acquired greater versatility in recent years.

Two and a half decades ago, earthmoving equipment consisted principally of gas tractors, scrapers, bulldozers, and excavating shovels. In contrast, today's earthmoving and heavy construction equipment includes diesel tractors (both track type and wheel type), diesel and gas trucks, diesel and gas excavators, scrapers, rock and dirt trailers, compactors, compressors, rippers, and various attachments for basic machines used for specialized work in clearing, pioneering, and grading.

At no time in history have there been such vast improvements in design and application techniques for grading equipment as those that have taken place since the 1948 Road Show. No longer can the contractor afford the luxury of approximate estimates of production and submit "today's prices based on yesterday's bids." He must know the production and performance capacity of his men and machines in order to be successful in competitive bidding. In too many cases, bidding is below engineer estimates in spite of higher costs of labor and material. Increasing the productivity of labor by making available more powerful, more efficient, more dependable equipment is a partial solution to the rising cost of equipment and labor.

Changing job conditions

Another reason for the trend toward larger and more productive equipment is changing job conditions. The great surge forward in the development of new and more adequate highways has brought with it plans for making cuts and fills through areas that a few short years ago would have been bypassed. The increased emphasis on safety requires us to go through terrain which formerly we would have gone over or around. Furthermore our roads are wider—often four or more lanes—with adequate shoulders and proper approach lanes.

These new highways are expensive, but they are cheap in comparison to what we have already paid in human lives—proving the folly of driving six times as many automobiles twice as fast and ten times as far as our present road system was designed to carry in the 1920's.

The challenge to the earthmoving contractor today, in view of the 27-billion-dollar road program is, "What is the best bargain?" implying that equipment and management selection must be capable of producing the greatest net profit.

According to the Bureau of Public Roads, the average bid price has remained relatively constant at about 36 cents per cu yd over a period of years that has seen machinery prices double and labor costs triple. The reasons for this are many, including the highly competitive nature of the construction business, the ingenuity and aggressiveness of rugged individuals, the improvements in methods and the demand for greater equipment performance and new products. In this latter area, that of new equipment and/or increased performance, the equipment manufacturers have made a substantial contribution. See Fig. 1.

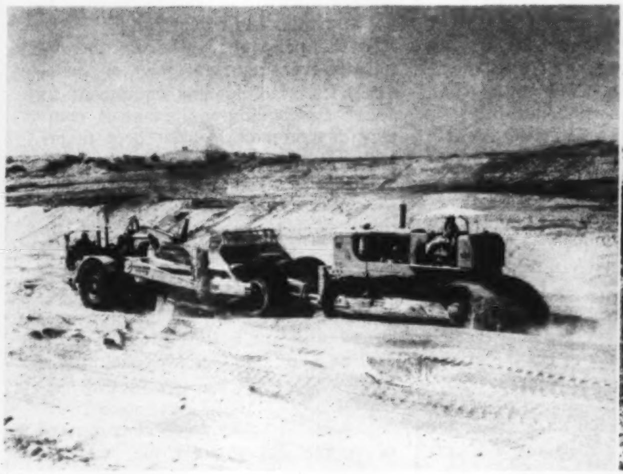
Grading and excavation methods have been revolutionized since 1929 with the advent of the tractor-drawn scraper and, shortly thereafter, of the rubber-tired earthmover. That era,

GRADING

R. D. EVANS

Staff Consultant, Sales Development,

Caterpillar Tractor Company, Peoria, Ill.



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Jobs are now dependent on fleets of rubber-tired machines that run in well-managed cycles at high speed. Track-type tractors are kept busy at push-loading, as on road construction near El Paso, Tex., pictured in (3), where Caterpillar D9 tractor equipped with push plate loads DW21 tractor. In (4), shopping center in Waco, Tex., is being excavated by Caterpillar No. 955 Trax-cavator. Productivity of crawler tractor has been greatly increased since 1948.

though impressive, is past. Just compare the equipment shown at the 1948 Road Show with that of the 1957 Road Show. Explore the improvements in four basic types of grading machines—track-type tractors, wheel-type tractors, motor graders, and trailers or trucks and shovels.

Track-type tractors

Although the track-type tractor of 1948 was established as an essential tool of the grading phase, its application in heavy work was limited, including only clearing, pioneering, pulling scrapers and push-loading. Today the track-type tractor has grown up, added new muscles, and taken on many new jobs. This additional work is manifold, including more efficient pushloading of scrapers, improved ripping and brush and rock raking, to mention a few. Even the bulldozer blade has been improved with U-shapes and hydraulic tilt, and tip cylinders for greater production.

Productivity of the crawler tractor has been greatly increased since 1948 throughout its many applications. A major step forward since the 1948 Road Show has been the introduction of the large-size tractor with over 300 hp and a basic weight in excess of 25 tons. This type of machine is making the big jobs move at a faster pace and is handling tasks that used to be economically impossible.

The largest crawlers of 1948 had approximately 130 drawbar horsepower (dbhp), compared to today's comparable model of 155 to 160 dbhp. Although most sizes have had increases in drawbar horsepower of only 10 to 15 percent, engine horsepower is up considerably more. This power is used for boosting brakes, steering controls, and other features for operating comfort or safety.

Manufacturers have done much to increase the on-the-job availability of machines. Metallurgy has made great advances toward reducing track wear, despite more speed, weight, and horsepower. Steering and master clutches have been completely redesigned with new features to combat friction.

Many options have become available to provide more specialized application of crawlers to special jobs. Choices of speed ranges, starting methods, and sizes and types of track are now offered. The larger machines can be purchased with either direct drive or torque converter drive, depending on application and preference.

Another economical advantage of these big crawlers is their ability to rip

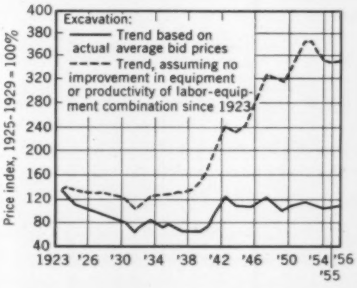

FIG. 1. Improved equipment has held highway construction prices at relatively stable level despite increased cost of labor, equipment, and materials.

up many soils for efficient scraper loading which previously had to be drilled, blasted, and shovel loaded. And now, with the ripper mounted on the tractor, the ripper can utilize the weight of the tractor for penetration, and then can be raised out of the way, allowing the tractor to maneuver effectively to handle other jobs.

Wheel-type tractors

At the time of the 1948 Road Show, wheeled tractor-scraper combinations were generally limited to long-haul assignments. They were considered a specialized tool—lacked traction and maneuverability on steep grades, especially under adverse conditions. In many cases they were overlooked in favor of the self-loading crawler tractor-scraper combination, frequently even where job conditions were favorable to speed.

Today "Big Rubber" has become the heart of the excavating-grading phase of construction. Jobs are now dependent on fleets of rubber-tired machines that run in well-managed cycles at high speed. Track-type tractors are now kept busy at push-loading exclusively. Even tandem pushing has been used advantageously for loading under some conditions.

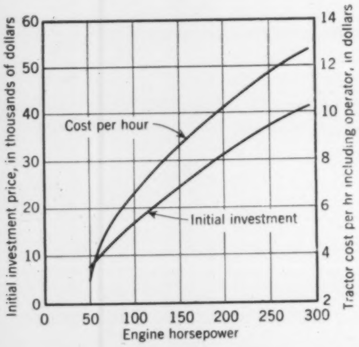

FIG. 2. Initial investment and operating costs of today's grading equipment have climbed.

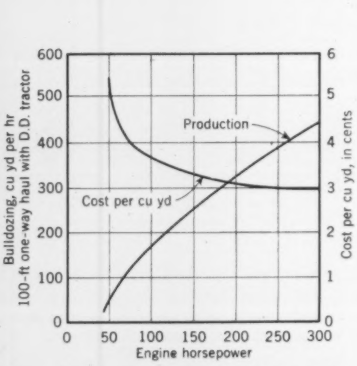

FIG. 3. Increasing productivity of labor by making available more powerful and more efficient machines is partial solution to contractor's problem. Chart shows effect of increased horsepower on production and on cost per cubic yard.

Because there has been a definite need for both two-wheel and four-wheel tractors, major advances have been made in both. Besides the various improvements in operator comfort and safety, these machines can boast up to 50 percent more horsepower than they had in 1948. The development of the turbo-charger was instrumental in providing this greater, more efficient power.

Again, improvements in metallurgy and welding, and the introduction of tubeless tires, are keeping these machines on the job longer than ever before.

Much has been done to speed the loadability of the scraper in the past few years. The modern scraper is wider, lower, and longer to provide faster loading and less lifting of the material. All this adds up to wide acceptance of today's wheeled tractor-scraper as *the* high-production tool in medium to long-haul earthmoving. Many of these modern rigs are moving more than 2,000 cu yd per 8-hour shift under average conditions, whereas the machines of 1948 were producing only 60 to 75 percent of that amount under similar conditions. Except under traction conditions that limit their use, the wheeled tractor-scraper is an essential tool for keeping grading costs in line.

Motor graders

Just before the 1948 Road Show, the motor grader grew to 100 hp. Today its most accepted size is 15 to 25 percent above that. In addition, operator comfort and machine dependability have been improved, and great strides have been taken in new attachments.

New versatility has been added to the motor grader because of these attachments. A good example of this is the elevating grader, a modern refinement of the old pull-type machine, which can now be mounted as an integral part of the grader. Certainly one of the most spectacular attachments to appear since 1948 is the automatic blade leveler. This device will hold the blade to a predetermined grade against terrain irregularities and will cut most of the time and guesswork from finish grading.

Trailers and trucks and shovels

Rear-dump trucks and bottom-dump and rock wagons have a place in many phases of construction where top loading is most practicable. The shovel and dragline fit in naturally where rock and similar materials are encountered. In 1948, the principal sizes in heavy construction were 1½- and 2-cu yd machines, loading haul units with capacities of from 12 to 18 tons.

Increased horsepower available for hauling units after 1948 provided capacity in units up to 50 tons—20 to 25 tons in single-axle units and 32 to 35 tons in dual-axle, and similar capacities in wagons and trailer units.

At this point, it may be well to consider the ever important phase of choosing the sizes of loading equipment to match the hauling equipment. A common denominator has not been determined as it is largely a matter of economics and involves many factors. To the grading or earthmoving contractor, the basis for size can be summed up in the rule-of-thumb—a maximum of four or five passes to the load. To meet this rule, shovels and draglines in 3-, 4-, and 5-cu yd sizes and larger are required and are available to load the present haul units. Besides diesel power, diesel electric units have proved successful.

Belt loaders provide another method of loading dirt to meet the increased loading demand for proper "sizing." Outputs from 600 to 1,200 cu yd per hour have been realized with these units.

Major improvements in shovels have been achieved by the extensive use of alloy steels to give greater strength with less weight, simplified and improved power-actuated controls, increased operator comfort and torque converter—all to obtain better performance.

In trucks and trailer units, increased horsepower, better use of high-strength steels, torque converter and automatic transmissions, better flotation, tubeless tires, increased speeds, and operator comfort have contributed to better performance and lower grading costs.

Although this discussion has considered only four types of grading machines, there has been extensive redesign and improvement in tractor shovels, compactors, and other tools used in this phase of construction.

Despite the fact that the initial investment and operating costs of today's grading equipment have climbed (Fig. 2), the overall productivity has more than kept pace (Fig. 3).

When properly selected and managed, the grading machines seen at the 1957 Road Show all give "more for the money" than their counterparts in 1948. This equipment combined with talented contractor management not only will make today's grading jobs a bargain for the American public, but will open up a frontier of new projects for better living heretofore considered impossible.

A. C. CLARK

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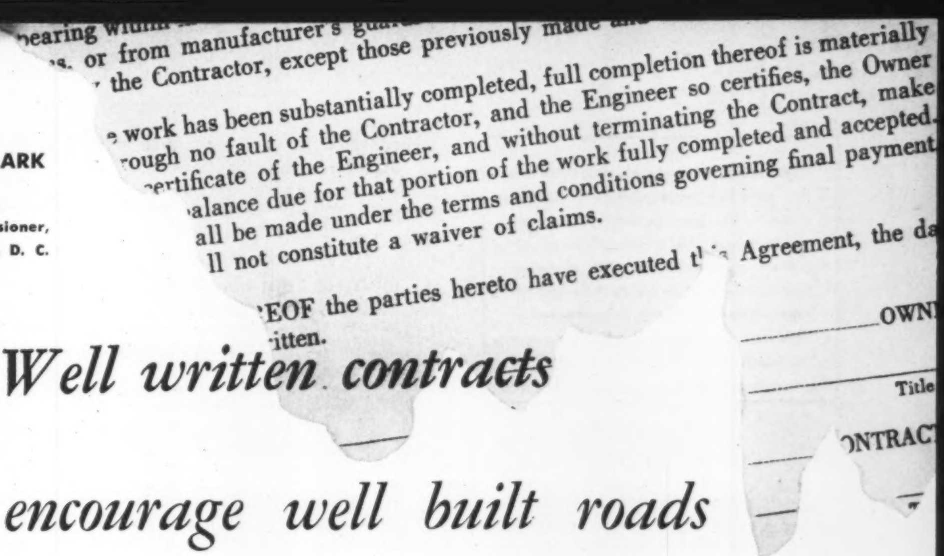
Bureau of Public Roads, Washington, D. C.



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Well written contracts encourage well built roads

Recently enacted legislation, providing for an unprecedented expansion of our nationwide highway program, recognizes the urgent need for making available highway facilities that will be adequate to meet existing and prospective future traffic requirements. If these objectives are to be fulfilled, this tremendous highway venture must be undertaken realistically, cooperatively, and aggressively.

Despite the impact of this huge program, compounded with a shortage of trained engineers and of some types of construction materials, the work must be accomplished in a minimum of time and without any letdown in design or construction standards. It would be extremely unfortunate and shortsighted to risk impeding the progress of the program, unnecessarily increasing the cost, and detrimentally affecting the quality of the construction through failure to take aggressive action to eliminate or modernize any archaic or provincial provisions of contracts that might tend to confuse, irritate, or delay the operations of an active and dynamic contracting organization.

It would be impossible to enumerate here every existing and potential problem with all its possible solutions. However, a number of needed improvements can be pointed out. Such improvements in highway contracts and in precontract procedures should contribute greatly to both progress and economy in all future highway construction. These primarily concern changes in design standards and construction requirements that were adopted under conditions quite different from those of the present time. These policies have been retained in spite of the need for modernization. Highway construction will always be subject to changing conditions with the resulting need for frequent changes in policies, standards, and specification requirements to keep abreast of improved methods as they are developed.

The usual and preferred method for accomplishing highway construction is by means of contracts based on competitive bids. A contract is defined briefly as "a written agreement, legally enforceable, between two or more parties." In highway contracts, the engineer of the highway agency is ordinarily responsible for all the engineering phases of the project, and the contractor is responsible for the construction. This separation of responsibilities provides a system of checks and balances with the engineer interested in getting high-quality work performed in minimum time and at the lowest possible cost to the highway agency while the contractor has a definite incentive to find means of performing the work as economically as possible to assure a reasonable profit to himself. A well written contract is essential.

Integral parts of the contract

There are many things to be considered in the preparation of a highway contract. While we are all familiar with the usual construction contract assembly, it would be well to review the documents included in it so as to emphasize its important features and indicate ways in which it might be improved.

Highway construction contracts consist of the following parts: (1) Invitation for Bids, (2) Instructions to Bidders, (3) Proposal, (4) Bid Bond, (5) Contract Bonds, (6) the Contract itself, (7) Standard Specifications, (8) Supplemental Specifications, (9) all General and Special Provisions, (10) General and Detailed Plans, (11) Notice to Proceed, and (12) any written order and agreements required subsequent to the execution of the original contract to complete the construction in an acceptable manner. All the foregoing documents are combined to constitute one instrument—the contract. They are essential parts of the contract, and their value is enhanced greatly by providing, to the greatest extent possible, both a clear and a complete coverage in each part.

The **Invitation for Bids** is the means used to advertise the proposed work and to solicit proposals from contractors. In this document the contracting authority indicates the quantity and location of the work and the time and place for the opening of proposals. In scheduling the bid opening in relation to the issuing of the Invitation for Bids it is of great importance to allow adequate time for prospective bidders to inspect the work, arrange for financing and purchase of materials, and prepare their bids.

Equally important are the **Instructions to Bidders,** which contain information necessary to the prospective bidders with respect to the provisions, requirements, and instructions pertaining to the method, manner, and time of submitting bids. These instructions should give in detail any unusual bidding requirements, with the steps necessary to meet them. Information should also be given regarding prequalification, licensing, and any other local requirements aimed at weeding out contractors not qualified to perform the work. The individual contrac-

OUR present highway specifications are the result of an evolutionary process in which the improvements made have resulted from the efforts of many engineers and contractors. This evolution must continue in order to take advantage of the continuing advancement in construction practices, equipment, and materials.

tor's qualifications should be determined on the basis of his available finances and equipment and his construction experience and prior work commitments.

Bidding requirements should never operate to exclude any responsible bidder. The maximum use of all available qualified contracting capacity will be a decisive factor in completing the highway program provided in the 1956 Highway Act. It must be borne in mind that the Act provides for an interstate system of highways that is to be completed within a fixed time limit and for an expanded program for both regular federal-aid and public-domain work which must progress simultaneously with the interstate program.

This brings us to the contract **Proposal,** which is the contractor's offer to perform the advertised work and furnish the labor and materials at the prices bid. The Proposal of the successful bidder is, of course, an integral part of the contract. The Proposal includes or identifies in detail the various documents that apply to the contract and are to become a part of it, such as the Plans and Specifications.

The part of the contract that results from the various preliminary documents and considerations mentioned above is the instrument by which the contractor is bound to perform the work and furnish the labor and materials, and by which the contracting authority is obligated to compensate him for the various items of work on the basis of his bid prices.

A well written **Contract** is one that defines completely the rights and responsibilities of each of the parties to the contract with regard to legal, financial, and engineering considerations. It will also describe the work to be done, the time in which it is to be completed, the legal responsibilities of the contractor and the engineer and their relations with the public, the bases of measurement and payment, and the amount of liquidated damages for failure to complete the contract on time.

For highway construction contracts, most of the foregoing material has been incorporated by each state into a box of **Standard Specifications** that is made a part of each contract by direct reference. These Standard Specifications are usually divided into three parts: (1) the general provisions which set forth the legal obligations, rights, and relations of the parties to the contract; (2) the various items of work commonly specified in the particular area and the materials to be used, construction methods, method of measurement, and basis of payment for each of the construction items; and (3) the materials required.

There are many ways in which specifications contribute to a well written contract. Our present highway specifications are the result of an evolutionary process in which the improvements made have resulted from the efforts of many engineers and contractors. This evolution must continue in order to take advantage of the continuing advancement in construction practices, equipment, and materials.

Uniformity in specifications is important

There was a time when specifications were limited in application to a single locality or state and were written with that in mind. Such specifications were entirely satisfactory because the contractor's area of operation was likewise limited. Present-day contractors, however, frequently extend their field of operations over a number of states and many operate on a nationwide basis. Uniformity of specifications among the states is therefore extremely important in order that a contractor desiring to bid in a new locality may find the work there subject to specifications with which he is already familiar. This fact gives added significance to standard specifications in general and to the many possible ways for them to contribute to the program ahead.

The object in issuing Standard Specifications originally was to simplify administration and promote uniformity of practice in contractual relations. Much progress has been made in this respect by the adoption, in the general or legal section of the specifications, of the requirements in the General Provisions recommended by the American Association of State Highway Officials. The same is true with respect to the adoption of a similar form and arrangement for highway specifications. The standardization that has been accomplished in this regard has proved its value. There are also many features of the specifications relating to technical engineering aspects where standardization is both practical and desirable.

SPECIFICATIONS should prescribe standard processes that are agreeable, in so far as possible, to contractors, material producers, equipment manufacturers, and other interested groups. Contractors and such other outside groups are able to advise regarding unnecessary restrictions, cost generating factors, and many practical construction problems.

Standard Specifications are the instruments by which standardization can be accomplished. Specifications in current use for highway construction specify about fifty different kinds and sizes of steel reinforcing wire fabric for concrete pavements. No doubt this number could be substantially reduced. The same applies to the 26 different types and grades of liquid asphalt included in the specifications of the several states. Limiting the types of this material and the kinds and sizes of wire fabric reinforcement to a minimum would simplify production, distribution, and storage problems with resulting economies and earlier deliveries. The same principle no doubt applies to other materials and designs.

The advantages of standardization have also been recognized by the manufacturers of materials. A standard design for a beam guard rail has been adopted which provides for interchangeable parts regardless of the original source of the material. The same has been accomplished by the major manufacturers of corrugated structural plate pipe and pipe arches for field erection. They have adopted the same standards for depth of corrugations, size of plates, and position and size of punched holes so as to permit interchange of the various elements regardless of manufacturer. A like standardization should be considered for many other items.

Another aspect worthy of consideration for the improvement of highway specifications is the "end result" type of requirement. In our early specifications it was considered proper to specify in detail how each operation would be performed, what kind and sizes of equipment and tools would be used, as well as the results to be accomplished. This left the contractor no opportunity to use his initiative and ingenuity in devising new and improved methods, nor did it permit him to take advantage of the latest types of equipment—which might result in work of equal or higher quality at less cost. Since the contract makes the contractor responsible for the work, he should be permitted to use his own methods and equipment to the maximum extent practicable.

A good example of such a specification is found in the requirements in the 1955 Louisiana Standard Specifications for "Compaction of Embankments," which reads in part as follows: "Compaction of embankments shall be accomplished by any satisfactory method or methods that will obtain the density hereinafter specified, unless a specific method is provided by the special provisions." This type of specification should be adaptable to other items and used wherever possible.

The term **Supplemental Specifications** is used to designate those specifications that are intended for statewide or other general application but that were developed after the printed book of Standard Specifications was issued. It is expected that they will be incorporated in the next edition of the Standard Specifications.

In addition to the Standard and Supplemental Specifications of general application, it will usually be necessary to include in the contract assembly a number of **Special Provisions** to set forth special requirements pertaining to the individual project only. These Special Provisions should be limited to the minimum necessary to adequately take care of the unique conditions applicable to the job in question. They should not be used as a means of avoiding for a long period the revision of the Standard Specifications to bring them up to date.

The **General and Detailed Plans** constitute a most important part of the contract assembly and show by graphic representation the proportions, dimensions, and relative positions of the various parts of the proposed work. It is important that the Plans be clear and accurate and that they include all necessary details and dimensions for ready use by the contractor and the engineer. In so far as practicable the plans should be limited to the graphic representation of the work and to such notes as are necessary for a clear understanding of the work. Further description, requirements, and provisions should be included in the Specifications and the Special Provisions instead of being placed on the Plans.

Standard Plans available from Bureau of Public Roads

In the interest of economy and simplicity in both design and construction, standard plans for certain construction features and details may well be prepared for general application wherever appropriate. In this connection the Bureau of Public Roads has prepared standard plans for a number of different types and sizes of steel, reinforced concrete, prestressed concrete, and timber bridges. These plans may be useful to highway agencies as a guide in developing contract drawings. The plans, as revised in 1956, may be purchased for $1.75 from the Superintendent of Documents in Washington, D. C.

In the evolutionary development of specifications and plans to keep abreast of improvements in design, methods, and materials, we find much unnecessary verbiage and many ambiguous requirements. Much of this is of course a carry-over and consists of instructions of little or no value and of oft-repeated phrases that defy a definite interpretation. A good example is the phrase, "as directed by the engineer," which is probably the one most used. This seemingly would give the engineer unlimited authority. Inasmuch as the meaning is indeterminate, it is subject to varying interpretations and application by different engineers and hence introduces uncertainties against which the contractor must bid high enough to protect himself against the worst conditions that might develop. All such unnecessary language and indefinite requirements should be avoided.

Along with the many improvements in specifications and plans to adjust them to changes in the highway engineering and construction field, there have been changes in the methods used to prepare specifications. There was a time when specification writers seemed to prefer preparing their specifications behind closed doors. The resulting document was, in many cases, all in favor of the contracting authority, with many details of the work specified as incidental to other work and all the risks to be assumed by the contractor. This may have required less field and office work for the engineer, but the contractor's bid prices habitually reflected the real or possible risks involved. One example would be the practice of making pipe excavation an incidental included in the bid price for the pipe. The contractor is obviously unable to estimate the amount of excavation that will be required and therefore to be safe must necessarily raise his bid price for the pipe.

THERE was a time when specifications were limited in application to a single locality or state and were written with this in mind. Present-day contractors however, frequently extend their field of operations over a number of states, and many operate on a nationwide basis. This fact gives added significance to standard specifications in general and to the many possible ways for them to contribute to the program ahead.

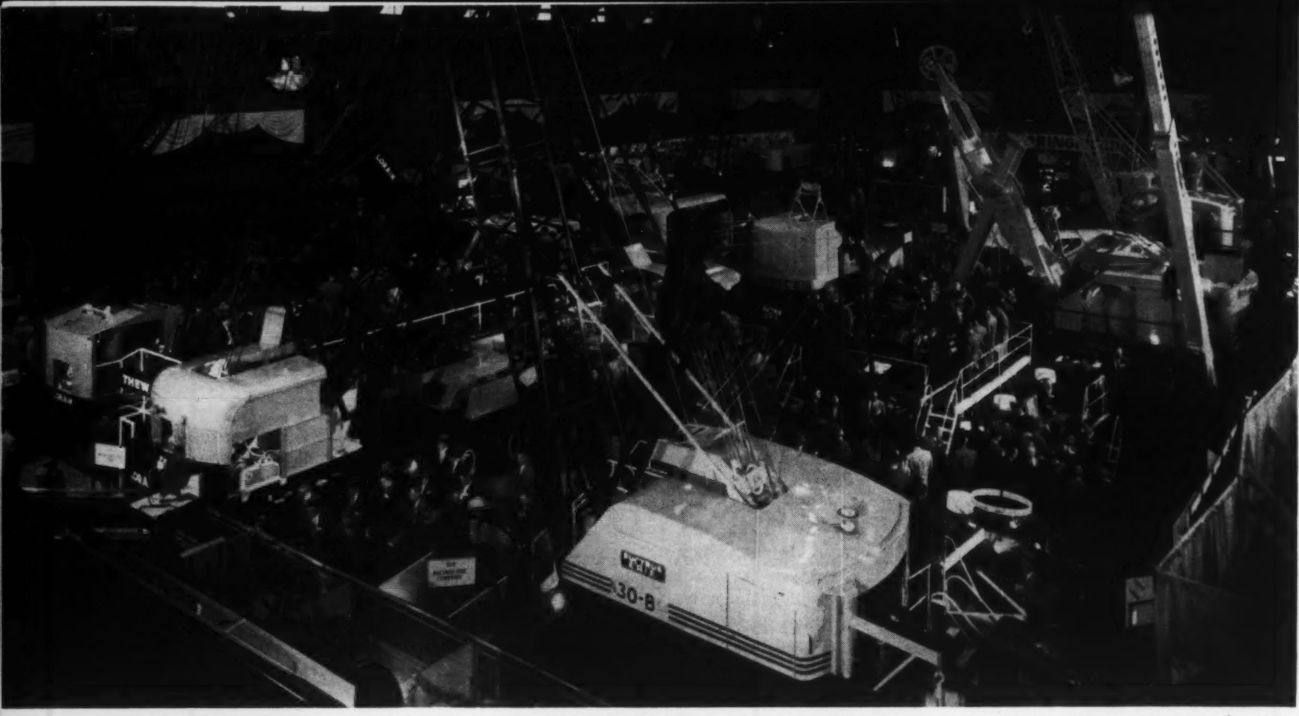
Contractors should be consulted

Specifications should prescribe standard processes that are agreeable, in so far as possible, to contractors, material producers, equipment manufacturers, and other interested groups. Contractors and such other outside groups are able to advise regarding unnecessary restrictions, cost generating factors, and many practical construction problems. Specifications prepared in this way will be better understood by both the engineer and the contractor; they will be definite, clear, concise, and fair —all desirable features for any specification. The current trend in preparing specifications therefore favors seeking the assistance of contractors and other interested groups.

The Bureau of Public Roads used this procedure for the first time in preparing the latest revision of its Standard Specifications. It was realized from the start that more time would be required for the preparation of the specifications if the assistance of these groups were sought, but the assurance of a better end product was considered to amply justify any delay that might be involved. The contracting industry was approached through the national office of the Associated General Contractors of America, and the many manufacturers, producers, suppliers and other contractors through the American Road Builders' Association. All suggestions and criticisms offered by the individual members of these associations were reconciled and furnished to the Bureau through these organizations.

This was very beneficial in accomplishing the objective of improved and practical specifications, identified as FP-57, which are expected to be off the press and on sale by the Superintendent of Documents within the next few weeks.

There are too many factors that contribute to a well written contract to single out any one for special mention. Improvements are continually being made all along the line, and the need for improvement will continue as long as progress continues.



Buyers jam Chicago's International Amphitheater for Road Show. Ninety percent of $12 million worth of equipment shown was sold in less than a week.

NEW TOOLS for the road builder

R. K. LOCKWOOD, A.M. ASCE

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New York, N. Y.

Probably 95 percent of road construction is performed by machines. Without them the bold Federal Highway Program would be impossible. Their productive capacity and capabilities are the key to economic highway design. That these facts are well known is attested by the 55,000 engineers, contractors, public officials, and equipment people who filled Chicago's International Amphitheater for the 1957 edition of the Road Show. Better than 12-million-dollars worth of equipment was on display, and the way it was

New Mammoth rear-dump PR21 by Athey will carry 22.5 cu yd, has 60-deg body tilt.

Mammoth off-the-road truck is displayed by R. G. LeTourneau for first time. Transporter is capable of hauling 35 tons across country to construction sites where roads or trails already exist.

being bought "off the floor" was evidence enough that the Federal Highway Program is really under way.

Of the nearly three hundred exhibitors who came to the show, few if any were without some new item of equipment. Some manufacturers showed entirely new machines; others brought out modifications of existing lines. Some introduced new attachments. All changes, however, reflected a continuing design effort to produce more highway, to a higher standard, per construction dollar. The effort is not necessarily altruistic. In a highly competitive field such as road construction, that is the way to sell more equipment.

This goal of better roads for fewer dollars has been approached in several different ways. Predominant effort was towards greater productivity in the form of more horsepower, larger machines, easier maintenance, and easier operation. The second chief development has followed the more demanding specifications of highway designers in the control of subgrades and in the placing of pavements. New equipment, unheard of a few years ago, is now available to perform highly specialized functions, particularly in compaction.

Perhaps to offset this tendency for more items of specialized equipment on the job, manufacturers are now developing and selling lines of special attachments for the conventional machines, sometimes referred to as the "hundred-bladed pocket-knife concept." These developments all have their place in the road building industry. They are the new tools of the designer and builder. They are the reason why, with spiraling costs of labor and materials, it is still cheaper to move a yard of earth today than it was 25 years ago.

It would be impossible if not unwise to try to list all the new machines, attachments, and gadgets introduced at the Road Show. The following is a random sampling selected only to illustrate the two above mentioned trends. These machines are not necessarily the most spectacular or the most significant, but they do typify these two trends in the equipment field.

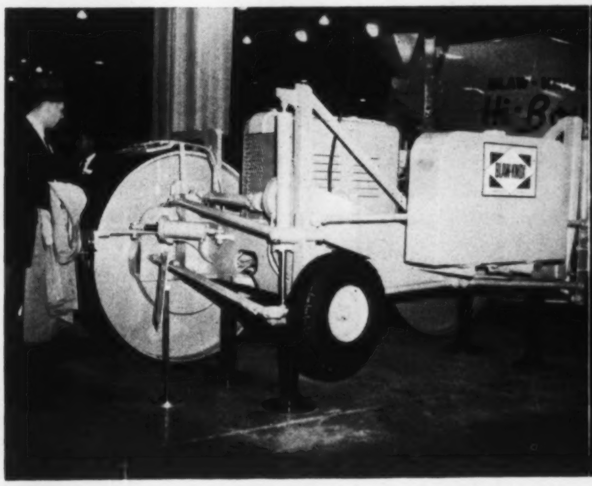
Size is probably the most obvious way to attack the problem of getting more earth moved per hour. The Woolridge–M-R-S 34-cu yd struck-capacity scraper is representative of the effort to get more yards moved per haul. A special hydraulic weight transfer attached to the goose-neck of the scraper can increase the load on the drive wheels of the M-R-S 250 tractor for greater traction—end result more weight per load and more trips per hour. Le Tourneau-WESCO unveiled a 27-cu yd version of its Fullpak scraper. Its 293-hp Cummins diesel is capable of speeds better than 28 miles per hour.

Ease of operation is directly proportional to production, since it is the operator who controls the rate of output. Along with comfort (foam rubber seats, air conditioned cabs, and similar creature comforts), the big words at Chicago were torque conversion, power steering, and power clutching. In the way of simplicity of operation, Thew-Lorain has reduced power-shovel control to two levers. The following motions can all be controlled by two levers—swing right and left, travel forward and reverse, crowd and retract, boom derricking and lowering, secondary hoist, clamshell holding line, dragline or hoe drag-in, power-load lowering, and control of the third drum. Eimco also has developed a finger-tip control comparable to the automatic transmission of an automobile.

Ease of maintenance characterizes Michigan's line, which has complete part interchangeability. The new LW30 eliminates springs and chassis grease fittings. Its final drive train can be removed, as can other elements, individually. The entire steering system is protected above or within the frame line.

As time goes by and we learn more and more about road building, engineers have been able to build more into a highway. Particularly in the placing of subgrades has this been true. Designers have been demanding, and getting, controlled road foundations. Uniformity of subgrade is essential if an efficient, economical, and long-lasting roadway is to be achieved. Equipment manufacturers have been alert to these demands. Heavier compactors as well as vibrating rollers are now on the scene. Typical of this effort to keep up with the designers is Seaman-Andwall's Trav-L-Plant, which mixes and moistens selected subgrade in one operation.

It would have taken a week just to study the new special soil compacting equipment. Asphalt and concrete plant



Special machines for special jobs was one of the trends evident in Chicago. Here shown is Blaw Knox's trench roller, significant of development of lines of maintenance equipment.

LeTourneau-Westinghouse representative explains radical new design of LW-30, off-the-road truck with pneumatic shock absorbers instead of springs and double the usual under clearance.

development also leaned heavily on quality control, with controlled batching the main feature.

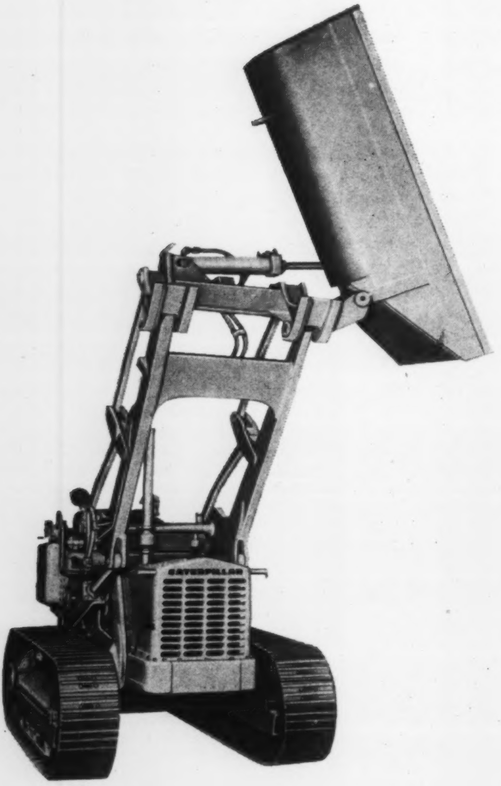
Among the items of special equipment to catch the eye at the Road Show was Traxcavator's new side-dumping bucket attachment. The advantages of in-line loading have long been obvious—simplified operation, less wear on equipment, and more speed. Hyster's new D4 backhoe further extends the trend toward multiple-purpose equipment.

Another special device has been added to the assembly line of paving equipment characterizing modern concrete paving methods. Seaman-Andwall has introduced a device for making joint sawing easier. This is a vibrating bar which, forced down into the wet concrete at the location of the joint, before the screed passes, pushes the coarse aggregate aside and creates a plane of weakness in the slab at the line across the pavement where the joint later will be sawn. The result is faster sawing, fewer broken saw blades, and controlled cracking at the joint.

All lines of construction equipment followed the same trends of faster operation at lower costs. McKiernan-Terry introduced a new compound air-steam hammer which almost halves the motive power of conventional hammers of similar rated capacity. Monroe Calculating Machine Co. introduced a new calculator capable of performing three-factor multiplication in one continuous operation.

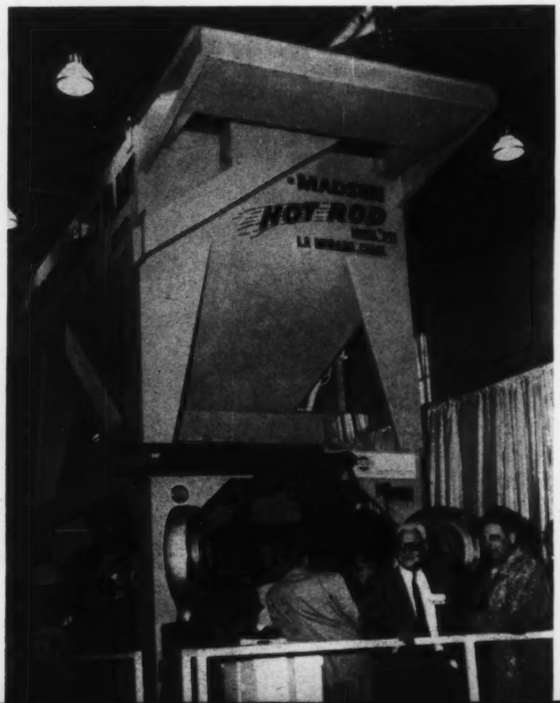
Clarence E. Killebrew, Vice President of the Clark Equipment Company, pinpointed the construction industry's attitude when he said, "In few other industries is it possible to establish so graphically and so accurately the cost of doing a piece of work as in road building and earth moving. . . . Construction machinery not capable of performing efficiently and at a low cost is quick to come to the attention of its owners. In most cases, the only solution is to furnish the operator with a new machine—one that can turn out the volume of work that will enable the contractor to compete in today's labor market."

That the construction industry is tooled up for the mammoth road building program was obvious at Chicago. It was also obvious that the equipment designers are not resting on past laurels. Design advances have created one problem however. With the swing toward welded construction for equipment, manufacturers are dependent on the availability of structural steel, a commodity in very short supply. Many of the bright and shiny machines and ideas making their debut on the floor of the International Amphitheater, consequently, will not be widely available immediately. Nevertheless, the construction machinery industry seems primed for its latest assault on road-building costs.



Among new lines introduced by Caterpillar was this side-dump bucket for Traxcavators for in-line loading.

Madsen's new asphalt plant drew crowds to Baldwin-Lima-Hamilton booth. Plant capable of turning out 250 tons per hour has special bin, designed to eliminate segregation.



Special feature of Allis-Chalmers exhibit was scale-model cement plant, demonstrating ACL double-pass traveling grate system. Reduction in length of 40 percent over conventional long kiln, and great reduction in stack-discharge dust, makes plant usable in urban areas. System requires only 60,000 btu per barrel of clinker compared with 750,000 to 1,000,000 btu by present methods.

AC
ALLIS-CHALMERS
ACL System

McKier
GENERATOR

Developer J. J. Kupka of McKiernan-Terry (at right) explains operation of new compound steam-air pile hammer to Syracuse distributor Steven Kravec. The C-5 is said to halve power required by conventional hammers of similar rated capacity.

Hyster "came to the fair" proudly showing its new D4 hydraulic backhoe, here shown mounted on a Cat D4. Simultaneous swing and hoist reflect design trend toward greater production and ease of operation evident throughout show.

Over-the-top loading distinguishes this Eimco loader. Simplification of operation marks major emphasis of equipment designers on greater output.

"Road signs while you wait" was featured in Minnesota Manufacturing and Mining exhibit. Demonstrator, foreground, applies printed plastic sheet to precut steel plate ready for baking. Finished reflectorized sign is seen in background.

Contractors will take road

ARCHIE N. CARTER, M. ASCE

Vice President and Treasurer,

Lindsey, Carter & Associates, Inc.,

Excelsior, Minn.

The author agreed to prepare this article prior to his decision to resign from AGC after nearly nine years as manager of the Association's Highway Division. His contribution is welcomed not only because of this connection but also because of his work on the Executive Committee of ASCE's Highway Division and his wide experience in highway engineering.

Two huge mixers pour half-mile of road a day on Kansas Turnpike.

Although it will need to overcome several serious problems, the highway contracting industry will take the expanded road construction program in stride. This conclusion has been reached after working closely for nearly nine years with the highway members of the Associated General Contractors of America, with all the state highway departments, and with the U. S. Bureau of Public Roads.

Because of the nature of their industry, contractors must keep their operations flexible and be able to expand their work rapidly as conditions dictate. The increased volume of road construction, sparked by the present highway program, will require many companies to expand. This can be accomplished while the planning and detailed design for the enlarged program are being completed, since time will be required for the awarding agencies to prepare for the award of contracts on the greatly increased volume of construction involved. Also, many contracting firms now engaged in other types of construction, such as the building of earth dams, are planning to participate in the highway program. This is an added factor that assures continued keen competition for road construction contracts.

Contractors must solve and gain aid in solving some major problems. First, it will be necessary for them to cooperate with the awarding agencies in adopting the new planning, design, and construction procedures which the highway departments must install if they are to overcome the engineering manpower shortage. Contractors are taking vigorous steps to provide this cooperation. In many states the contractors' associations have held meetings with key engineers of the highway departments to assist in revising the state's specifications and construction methods to save engineering and construction time.

For example, when the Bureau of Public Roads was revising its "Specifications for Construction of Roads and Bridges in the National Forests and National Parks," highway members of the AGC were invited to meet with top engineers of the Bureau to offer detailed suggestions for improving this important document. These specifications had not been revised since 1941, and in the intervening years many new construction materials, equipment, and procedures had become available. Many of the contractors' recommendations were adopted, and the new edition, which is expected to be available soon, will be better suited to expedite the enlarged highway program.

Many state highway departments have asked the highway contractors of their area to lend similar assistance in modernizing the state's specifications, contract forms and actual construction methods. Highway contractors must provide maximum assistance to their public highway agencies to make possible these desired improvements, because contractors have developed improved methods and procedures not now permitted by some outdated specifications. Neither can today's latest equipment, such as large vibrating compactors, be used effectively under some of the existing specifications.

New payment methods needed

Further, contractors must work with the highway departments in their states to evaluate new payment procedures for completed construction. Several highway departments are proposing that the contractor be paid for earthwork on the basis of quantities de-

program in stride

termined by photogrammetric methods without extensive use of engineering manpower to determine these quantities by the older ground survey methods. In fact, Pennsylvania has already paid for earthwork quantities calculated by photogrammetric methods, and Ohio and Massachusetts have let contracts on this basis.

It is most encouraging that at recent joint meetings of contractors and highway department engineers there has been agreement that all departments should conduct early test projects to provide actual experience with photogrammetric methods to determine pay quantities, with provision for some ground checking if tests show that it is needed. Some states have already carried out such projects successfully. Contractors all agree that if the volume of contracts awarded is to be increased, they must accept procedures which will reduce engineering time.

Highway contractors must also assist in encouraging more college students to enroll in civil engineering. Their firms will be competing with the highway departments for graduating engineers. Already much progress can be reported. Many individual contractors have established scholarship help, and a high percentage of the AGC chapters have set up scholarship programs. On the national level, AGC has an exceedingly active Educational Committee and so have many of its chapters. AGC has been working closely with the ASCE, the Engineering Manpower Commission of EJC, and the American Society for Engineering Education, on the problem of engineering manpower. This activity has included methods to improve the curriculum of the high schools so that more students can qualify for entrance into engineering colleges.

As one possible method of solving the engineering manpower problem of the state highway departments, the contractors on some projects have handled the "staking out" as part of their construction contracts. They have demonstrated that they can do this work effectively. However, because the forces of many highway contractors are unionized, some engineers employed by them on stake-out operations have been forced to join a union.

This experience indicates that careful study must be given to the matter before other highway departments assign field engineering operations to their contractors. Moreover, although the larger construction firms have engineering staffs, some small firms would need to employ engineers. Such firms would thus be competing with the highway agencies for highway engineers. These views are supported by the national Joint Cooperative Committee of ASCE and AGC.

Although the continued increase in the nation's total volume of new construction is creating a shortage of well trained equipment operators in some areas, this shortage should not delay the road program. Two reasons are cited for this view. First, contractors have always shown ability to train equipment operators, as many of their organizations have done when working in foreign countries. Second, more equipment operators are now being trained within the country. The National School of Heavy Equipment Operation, Charlotte, N. C., has been engaged in this activity for the past two years, and is training operators at the rate of 30 per month. This organization is in process of establishing a similar school at Weiser, Idaho. In the Chicago area, the heavy equipment operator's division of the Greer Technical Institute has a school in operation. If more similar schools are needed, they can be established without great delay.

Modernized highway laws urged

Contractors in many areas also face the fact that the road program may be delayed unless the highway laws of their state are made adequate to facilitate effective work. Many state and local highway departments are without adequate legal tools to build limited-access highways. Many departments need more legal authority to acquire the necessary rights-of-way quickly. Contractors must assist all groups interested in an effective road program in modernizing highway laws. Many contractor organizations are already working on this difficulty in cooperation with other groups. Since most state legislatures meet this year, contractors have an opportunity to provide extensive help.

As finally passed, the Federal Aid Highway Act of 1956 contained a provision that public hearings must be held by state highway departments before a federal-aid project can be approved by BPR. There is danger that only those organizations or individuals opposing a greatly needed and well planned construction project will take the trouble to participate in such hearings. Contractors must aid in solving this problem too. It is hoped that they will be present at the hearings and support the awarding agency. This assistance could be rendered in cooperation with automobile clubs and similar groups.

Additional cooperative work will be needed in some regions to sell the benefits of controlled access on interstate highways. Contractors must give aid on this problem also.

Cement shortage will disappear

Huge amounts of construction materials and supplies will be required for the road building program. Although cement was in short supply in some areas last year, this shortage is expected to be of short duration. A large expansion in the nation's facilities for producing cement is being completed. Contractors believe that this year cement in adequate supply will be generally available and that delays caused by the lack of it are about ended.

Neither is a major shortage of reinforcing steel expected. In contrast, structural steel will continue to be critical for several months and will be a major problem for the program as a whole. Contractors are still busy working with their highway departments on methods to solve this difficulty. Planning procedures that will permit the placing of orders for structural steel for a road project at the earliest possible moment are being initiated, and some benefit will result.

Maximum standardization to simplify fabrication procedures, substitution of reinforced concrete designs, including prestressed members, and other steps also will give some relief. However, slow deliveries of structural steel may be expected for some time. Nevertheless, by the time the construction program really gets under way, the steel shortage should be easing in view of the increased production capacity now being completed or planned by the steel industry.

Although delivery is slow for some types of construction machinery, production of this type of equipment is highly competitive and many manufacturers recently have completed large extensions to their plants or have additional capacity under construction. Moreover many contractors had much idle equipment last year. All indications are that any problems relating to equipment deliveries will be of rather short duration.

In expanding their operations, some contractors will need added financing. Because a large volume of construction is assured for the next several years, reliable road-building organizations should not have great difficulty in obtaining the required funds. Highway departments can help organizations with limited financial backing by paying a higher percentage than has been customary on partial estimates as the work progresses. In some states the contractor is paid only 85 percent of partial estimates of work placed. The policy favored both by contractors and by the Bureau of Public Roads is that of paying 90 percent of partial estimates until half the job is complete, and thereafter paying such estimates in full. This method results in an average retention of 5 percent for the full job, which is in contrast to the large retention previously practiced by some highway departments.

Desired uniformity among states

One problem often encountered by contractors is the lack of uniformity in highway department procedures from state to state. A survey of specifications, prequalification of contractors, bid bond requirements, performance bond regulations, and policies relating to liquidated damages shows a wide variation between states. Closer uniformity regarding these and other matters would simplify contractors' operations. It is granted that complete uniformity for the entire United States might not be possible, but uniformity within various regions does appear feasible.

Maximum standardization of plans from project to project within a given state is especially helpful. For example, uniformity of bridge design from job to job within a given state has permitted reuse of concrete forms and made possible many other savings. If this uniformity could be extended across state boundaries for the thousands of structures that will be needed in building the Interstate System, large economies would follow.

It is granted that numerous special structures will be required because of the many highly complicated traffic interchanges, but the maximum uniformity possible should be sought. Preparation by the Bureau of Public Roads in 1953 of the "Standard Plans for Highway Bridge Superstructures," with the recent revision of this document, is a useful step in this direction.

Handling traffic during construction

Seldom is a meeting between highway engineers and contractors held without discussion of the difficult problem of handling traffic during the construction of an existing highway. Fortunately much of the Interstate System will be built on new alignment, and the problem of bypassing traffic will not arise. However, in view of today's heavy traffic volume on almost all roads, reconstruction of a route under traffic will create many difficulties for both the contractor and the public.

Highway department representatives emphasize that contractors should assign some of their most alert and capable employees to duty as flagmen and similar operations in order to maintain good relations with the motoring public. In recent years many contractors, working in cooperation with their state highway department, have employed special uniforms or other identification, such as bright red vests and sun helmets, for their flagmen so that these men can be recognized quickly by motorists. This entire matter will require the continued attention of highway contractors.

Better and more uniform signs on construction jobs, to permit motorists to proceed safely through work in progress, may be needed in some regions. In recent years much time and attention have been devoted by engineers and contractors to this important matter in public relations. Continued attention to this problem by contractors and contractor organizations will be required.

Some additional problems that contractors will need to solve could be outlined, but those described are believed to be the principal ones demanding attention. It can be concluded that the contractors' problems are solvable and that they will be easier to solve than many of those being encountered by the state highway departments.

In looking forward to the expanded highway program, one should first look backward to World War II and the great expansion the construction industry was required to undergo in order to handle defense and war projects. The expansion of road construction capacity to handle the new highway program will be much easier than that. Taking into account the contractors' ability to organize, and the fact that contractors will be mobilizing, not for just one job but for an assured long-range development, only one conclusion can be reached. It is that contractors will take in stride the comprehensive road program made possible by the 1956 Act of the U. S. Congress.

New role of the

If there is any obstacle that might thwart the successful execution of the Federal-Aid Highway Program of 1956, it could be in the area of public opinion and public reaction.

Companion articles in this issue of Civil Engineering capably analyze basic facets of America's new highway program in such terms as administration, trends in construction equipment, problems of contractors, improved contracts and specifications, precast bridge design, and placing of subgrade.

Important as these things may be, in my opinion they fall into insignificance when compared with the obstacles that can be thrown in the path of this program by adverse public opinion.

Highway representatives and citizens of each state understand statistical data in terms of present and past experience. California is no exception. A quick glance back to the fiscal year 1944-1945, for example, shows a total expenditure for engineering, right-of-way, and construction of $24,743,770. Compare this with the anticipated budget for the 1957-1958 fiscal year—$354,812,051, or more than a 1,400-percent increase in the past 13 years!

In analyzing these two budgets, it must be noted that the right-of-way expenditure in the 1944-1945 fiscal year was $7,110,224, while that anticipated for 1957-1958 is $160,000,000. Each succeeding year, statistical analysis has underscored the increased importance of the right-of-way function in the over-all highway concept.

The following tabulation is indicative of the pyramiding dollar volume of right-of-way transactions in California:

FISCAL YEAR	CONSTRUCTION COST	RIGHT-OF-WAY COST
1952-53	$126,739,994	$ 36,280,756.73
1953-54	174,757,180	84,286,156.99
1954-55	143,584,063	94,346,211.80
1955-56	154,396,192	118,810,796.50
1956-57	150,193,000	134,676,400.00

Reasons for such dramatic increases in right-of-way dollar volumes in Cali-

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right-of-way agent—key to the highway challenge

fornia emphasize the ever-larger role played by right-of-way. The reasons can best be appreciated by referring briefly to two of California's most famous freeways—the Pasadena (known to millions as the Arroyo Seco) and the Hollywood. The Pasadena, a total of 8.2 miles, was completed in December 1940; it was hailed as "the West's First Freeway." Its construction cost was $10,434,200; its right-of-way cost, $1,009,100.

The Hollywood Freeway tells the story of the new importance and value of right-of-way. The ten-mile link, from Spring Street in the heart of the Los Angeles civic center to Vineland in the San Fernando Valley, was completed in August 1954. Its construction cost was $28,949,200; its right-of-way cost, $28,360,000.

A realization of this almost unbelievable rise in the right-of-way factor from approximately one-tenth of the construction dollar in 1940 to a full-grown fifty-fifty relationship with it in 1954, makes it possible to understand the portent, as shown by available statistics, for the Los Angeles Harbor Freeway. For the 11.3 miles completed or under contract as of January 1, 1956, construction costs are estimated at $29,778,300 and right-of-way costs at $48,600,000.

There will be no further discussion here of the statistical aspects of the highway program, for statistics always tend to selectivity. It is obvious that the above examples were selected to emphasize a *pattern* which has emerged and which demands recognition. The freeways cited in these examples are of course located in a vast metropolitan complex. Nonetheless the trend is true, and a study of less highly industrialized and less densely populated areas will reveal a similar if a less dramatic picture.

It is important, and should be obvious, that rising land values have had a great impact on the right-of-way picture. But this fact dwindles into insignificance when compared with other aspects of the problem.

The job of tomorrow, for the right-of-way profession, is developing and disseminating factual information so that public opinion can crystallize. If this is done, intelligently and faithfully, there can be little doubt as to the verdict of the American public towards the new era of highway transportation.

The integration of rural areas into the ever-expanding peripheries of America's cities has been brought about by a vast multiplication in population figures, increasing industrialization and urbanization. In a certain sense, range lands gave way to pasture lands, which in turn became ripe for subdivisions, and eventually necessary for the commercial and industrial expansion in the community pattern.

Restricted access

It is at this point that we must face, with vision and vigor, the new highway challenge. Just as our community patterns have been expanding almost beyond belief, so too have the patterns of the nation's primary transportation arteries been in a state of fluid growth. The essence of the highway challenge—and we must understand this in order to meet our new problems and responsibilities successfully—lies in the very nature of the new highway concept, which has been perhaps best expressed in the Federal Aid Highway Act of 1956.

The new highways have incorporated a provision which has been, generally speaking, little known throughout the country—restriction of access in order to assure permanence and efficiency. Most of the roads and highways we and our fellow citizens have known and used up to this very day are susceptible to community, and individual, encroachment. The roads seem to bend and twist from the pressure of each tiny community and every business and residential development.

All our citizens are accustomed to think in terms of ready access to a thoroughfare. This is a far cry from the emerging concept of access restriction and relative inflexibility to be incorporated in the new interstate and defense highways. A few of the states recognize the new concept, because they have been individually constructing a few miles of freeways to meet new community challenges, but generally speaking it is a shock of staggering proportions to envision the new interstate access-restricted "freeway" pattern.

Once constructed, our vast 41-thousand-mile network will be permanent by its very nature, and from the day of its completion on, communities will actually be conforming to the freeway pattern, not it conforming to them. Every aspect of community life—location, expansion, public buildings, transportation, location of public utilities—all will be predicated on the definitive outline of the freeway system.

In the light of this fact, the true nature of the right-of-way function becomes evident. It is now the imperative duty of the right-of-way man, in addition to his usual functions of contacting property owners affected by expanding roadway needs, to develop skill in patterns of community growth and their sociological implications, and in the public relationships arising from community planning.

Developing too, for the right-of-way practitioner, is the surprising new role of assisting and advising engineering staffs in the needs of the communities to be affected by the freeway system.

Those who have studied the Federal Aid Highway Act of 1956 understand that community meetings are now required in order to elicit every relevant bit of information which will help to integrate the community's needs with those of the nation's traveling public. Representations on behalf of governmental agencies must be made skillfully and efficiently.

Parenthetically, it should be noted that this procedure has been practiced in California for a number of years. This policy was established by the California Highway Commission as a matter of sound public relations practice; it is not a requirement of California law. The policy has proved sound—and rewarding. Economic data pertinent to each community, as related to freeway development, have been gathered by the Right-of-Way Department, Land Economics Studies Section.

This gathering of economic data on the needs of communities large and small will be one of the major functions of right-of-way representatives throughout the nation. They must then pass these data on to the planning and engineering staffs.

We have all become increasingly aware of the importance of the right-of-way man's work in making personal contacts. Every property owner must be assisted when right-of-way needs are being met. The sale of a home to the state for freeway purposes must be achieved according to a time schedule that will permit the home owner to be satisfactorily relocated. Basically the same policy, though somewhat more involved, must obtain for commercial properties and industrial complexes.

Relocation of utilities is an additional problem which calls for specialized right-of-way techniques. For example, utility relocations in California, during the fiscal year ending June 30, 1955, required the preparation and execution of 733 utility agreements involving the expenditure of approximately nine millions of dollars.

An equally varied set of problems is confronted in property management. Such management requires the collection of rentals during the interim period between the acquisition of the property and the time it must be cleared for highway construction. Gross rental and lease receipts for the California fiscal year 1954-1955 totaled $1,889,669.26.

Another familiar problem concerns the disposal of lands initially acquired for right-of-way but not finally needed for this purpose. Where there are excess parts of state-acquired properties, and of course state-owned improvements, these must be sold under a firm and consistent policy which permits their rapid transfer back to the tax rolls and which makes provision for the relocation of buildings for continued occupancy and use. In California, during the 1954-1955 fiscal year, 3,376 building improvements and 138 parcels of land were sold, realizing a gross return of $4,236,493.79.

Such activities as utility relocation, property management, and property sales are of course in addition to the well-known major work of the right-of-way staff—the appraisal and negotiation of properties required for right-of-way. These added functions are generally accepted throughout the country as representative of the expanded role of the right-of-way staff.

Another right-of-way job —economic studies

In California there was early recognition of two additional responsibilities of the right-of-way staff—the preparation of economic studies to determine the effects of highway construction on communities, and the maintenance of a long-range in-training educational program to keep all members of the staff abreast of the most recent information affecting such aspects as appraisal, negotiation, titles, right-of-way engineering, and condemnation procedures.

It has been my experience, in a lifetime devoted to the study of real estate and more than twenty-five years of responsibility with the California Division of Highways, that one of the most important activities now being carried out by my staff is the preparation and publication of dozens of carefully documented studies on the "before" and "after" effects of highway construction on community values and other community factors.

I am convinced that the nation-wide attention which has been directed to the California studies corroborates my belief that such studies are a vital and significant part of highway programming activities, and are an indispensable function and responsibility of the state right-of-way department.

But I must confess that the dramatic impact of the Federal Highway Program on this nation throws an even clearer light on the new role of the right-of-way department. It adds to the right-of-way man's task, as it has been pictured above (appraisal, negotiation, property management, utility relocation, economic studies), the broad new demands of the federal program in relation to community planning and community hearings, and the manifold new responsibilities of the agent in interpreting the new policy of access control to every individual in the community. Unless the right-of-way man fulfills these responsibilities, the reaction of the general public could be strong and adverse.

If an adverse public reaction occurs because of a want of helpful information concerning the implications of the new highway program, that program will collapse despite all the efforts of highway planners.

Public opinion will make itself felt in no uncertain terms. If the reaction is apathetic, the program may slowly grind to a halt; if it is adverse, it will be killed instantly. To become a success, the program must be welcomed by the public in the belief, based on facts, that this new integrated system is vital to the economic health of the community and the nation.

It is here that we see the right-of-way agent in his new role, facing the new challenge. It is the right-of-way man who will be making the intimate personal contacts, and it is he who will be facing community groups, constantly interpreting, explaining, translating.

Everyone who reads this article has the right to ask, "Where do we get men who can perform this type of public service?" Roll all these skills together—appraiser, negotiator, property manager, utility relocater, economic analyst, all the new demands for economic-sociologist and public counselor. This is the right-of-way man who is now needed—in fact demanded, by the new federal highway law.

The California Highway Commission has indicated its realization of these new demands by the passing of resolutions to declare 3,500 miles of the current highway system to be freeways. The present interstate federal system envisions only 2,189 miles in California, much of which will lie within the already declared 3,500. Under the guidance of the Commission, we have also pioneered in economic studies, in public relations counseling, and last but not least, in the invaluable function of training and education which is required throughout our right-of-way staff.

It is obvious that, as the community grows from a rural to an urban concept, and as land increases in value, more and more time must be devoted to the training of the right-of-way agent. In 1945 the average cost of a right-of-way parcel was $2,370.51; in 1956, $14,430.79. The over-all right-of-way program in terms of dollars is growing by leaps and bounds, and the requirements of the new policies demand increasingly superior skills.

The day is gone when right-of-way agents could receive some of their beginning training by handling low-value parcels in an agricultural pattern. Today the most skilled members of our staff must assist in the education of the trainees and must spend valuable time in passing on to the newer members of the staff the knowledge and skills required.

Just as the right-of-way program has grown in dollar volume, just as the responsibilities of the right-of-way agent have increased a hundredfold, so must the right-of-way staff increase in number and redouble its in-training educational program.

PRESTRESSED PRECAST bridge deck erected in eight days

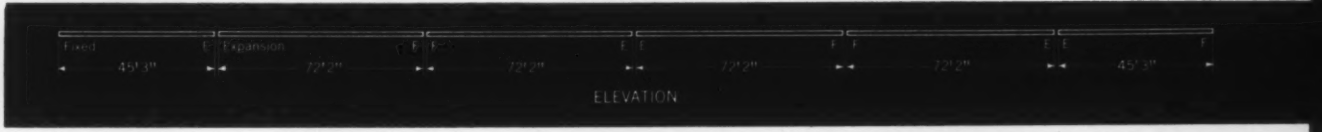


FIG. 1. Knight Road Bridge consists of four middle spans about 72 ft long and two end spans about 45 ft long.

JAMES B. LONG, M. ASCE

Consulting Engineer, Blue Bell, Pa.

For more than two years, construction of the Knight Road Bridge over the newly created Green Lane Reservoir was a controversial subject. This reservoir of the Philadelphia (Pa.) Suburban Water Company required the bridge roadway to be raised 24 ft.

Efforts were made to abandon the road, which connects two state highway routes, but these failed. A relocation of the road was also proposed, but rejected by a grand jury. The existing bridge was a four-span covered wooden structure, the last of its type in the county. It was suggested that this structure be raised by raising the existing abutments and piers. This solution was however not acceptable because the structure had a safe-load rating of only three tons, and was so narrow that two vehicles could not pass on it.

At a meeting of all parties concerned, held in May 1956, the Water Company agreed to raise the abutments and piers to the new elevation, and the Commissioners of Montgomery County agreed to erect a new and modern superstructure. The new bridge was completed and opened to traffic on December 30, 1956.

Plans for a prestressed precast concrete deck bridge were approved by the Court on June 8, 1956. This type of construction was chosen because the bridge was required to be completed by December of 1956 and because two plants specializing in precast prestressed concrete members were located within easy hauling distance of the site.

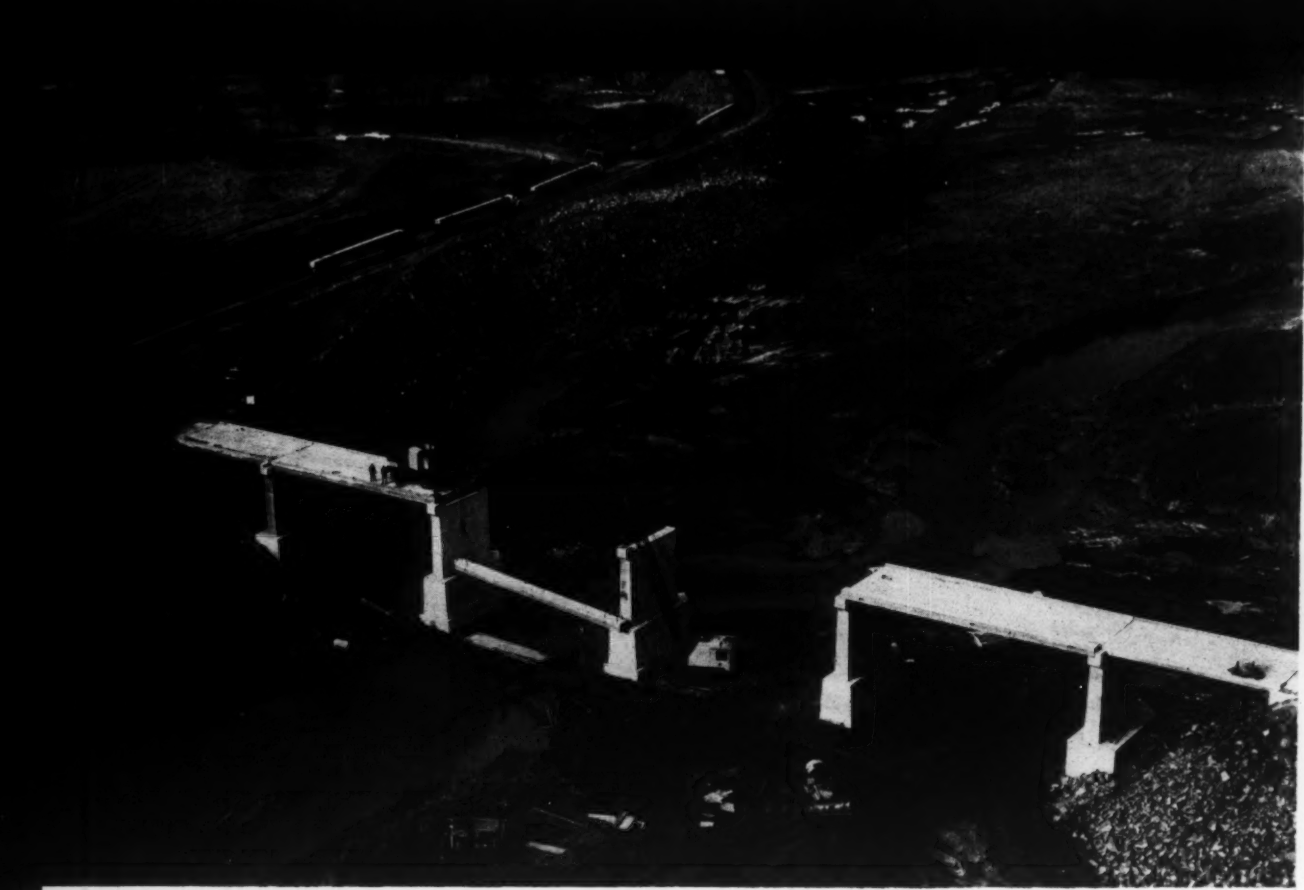
Bids were received on July 13, 1956. The contract was awarded to the lowest bidder at $105,200. The second bid was $109,750, and the engineer's cost estimate was $110,000. This represents a cost of $11.66 per sq ft of usable surface and includes the wearing surface on the roadway and the steel railings.

The bridge consists of four identical spans of 72 ft 2 in. and two identical end spans of 45 ft 3 in. (one at each end). See Fig. 1. All spans are simple, as shown in Fig. 2. The roadway is 20 ft wide and the sidewalk, on one side only, is 3 ft 9 in. wide. Each span is made up of eight hollow box-girder beams 36 in. wide. The beams in the 72-ft spans are 33 in. deep, while those in the 45-ft spans are 21 in. deep. The sidewalk beams are 27 in. deep in the 72-ft spans and 17 in. deep in the 45-ft spans. The bridge was designed for the standard H20-S16 loading.

Beams of pretensioned, bonded design

The beams are of pretensioned bonded design. As shown in Fig. 3, they are hollow. A rectangular hollow space extends the full length of the 72-ft beams except for solid diaphragms at the ends and at the third points. The sides and bottom of these beams are $4\frac{1}{2}$ in. thick, and their top, 5 in. thick. The prestressing tendons consist of 41 strands of $\frac{3}{8}$-in. diameter lying in a horizontal trajectory, and stressed initially to 150,000 psi.

The conventional reinforcing steel consists of inverted U-shaped No. 4 bars and four longitudinal No. 6 bars. The No. 4 bars are spaced 8 in. on centers and act in a dual role as stirrups and as transverse flexure reinforcing for the top side of the section. The longitu-



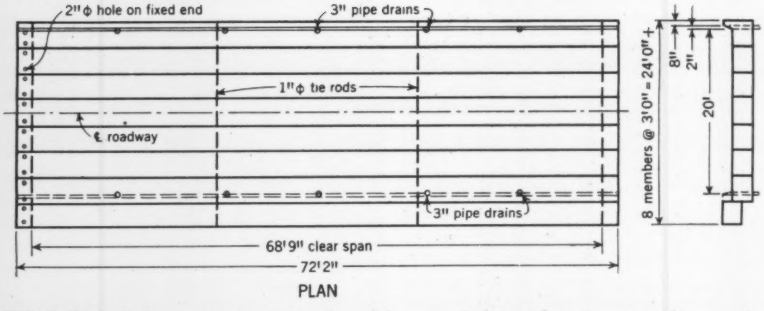

2"ϕ hole on fixed end
3" pipe drains
1"ϕ tie rods
℄ roadway
3" pipe drains
68'9" clear span
72'2"
PLAN
8 members @ 3'0" = 24'0" ±
8"
2"
20'

FIG. 2. Eight hollow precast pretensioned beams, tied together transversely, constitute complete floor system.

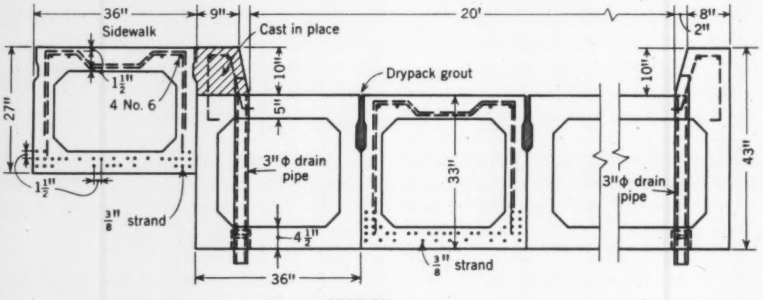
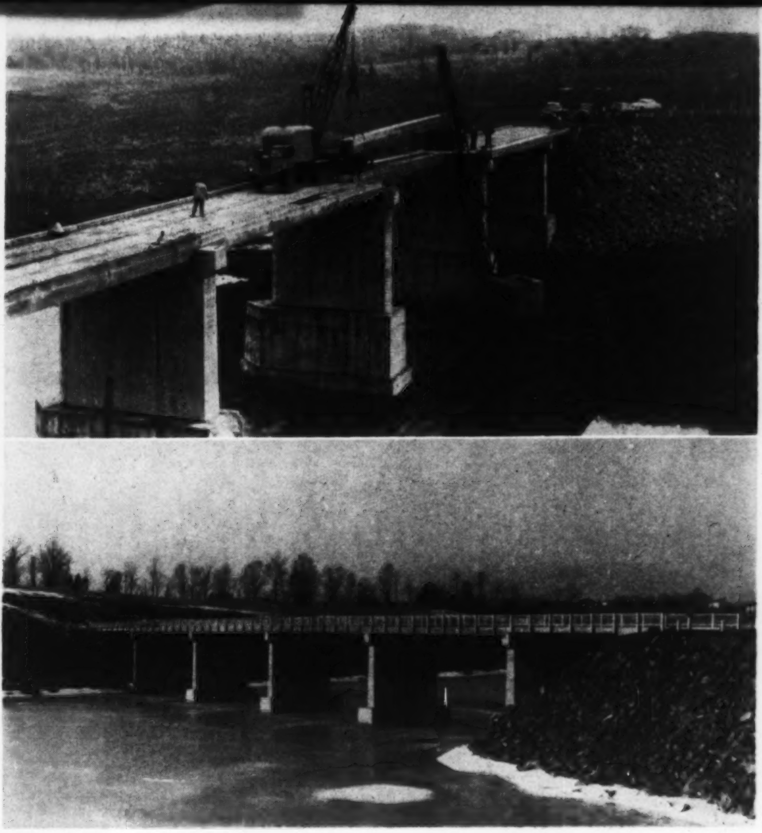

36"
Sidewalk
9"
20'
8"
2"
Cast in place
Drypack grout
27"
1½"
4 No. 6
10"
5"
10"
1½"
3"ϕ drain pipe
33"
3"ϕ drain pipe
43"
⅜" strand
4½"
⅜" strand
36"
SECTION

FIG. 3. Cross section through deck shows how standard beams were assembled in 72-ft spans. Note longitudinal shear grouting between beams.

dinal bars run the full length of the beam near the top fiber and serve to minimize the opening of shrinkage cracks and to tie the system of U-shaped rods into one easily handled unit. A complete 72-ft beam weighs about 24 tons.

The hollow space in the 45-ft beams for the end spans is in the form of two hollow tubes of 12½-in. diameter, extending the full length of each 45-ft beam except for solid sections at the ends and at mid span. See Fig. 4. Prestressing tendons consist of 31 strands of ⅜-in. diameter. The conventional reinforcing steel consists of inverted U-shaped No. 3 bars spaced 15 in. on centers and four No. 5 bars passing the full length of each beam. A 45-ft beam weighs about 16 tons.

The beams were manufactured on the prestressing beds of the Concrete Products Company of America at their plant in Pottstown, Pa., 10 miles from the bridge site. All pours were continuous and a high-frequency internal vibrator was used to compact the concrete in the forms. Vacuum treatment was applied for a 30-min period, followed by 36 hours of steam curing at a temperature of approximately 120 deg F. Concrete cylinders



Deck, composed of hollow precast, pretensioned beams, was placed in eight days. Note how original piers, which supported old bridge, were extended to raise deck 24 ft. As shown in view on facing page, first two beams in each span were raised into place by two cranes from trailer in stream bed. Remaining five beams in span were then placed by backing trailer out over beams previously placed, as shown at left, above. (Five beams on trailers are seen waiting on road at upper left in preceding view.) Completed bridge, with steel guard rail in place, is seen below, after filling of Green Lane Reservoir of Philadelphia Suburban Water Co.

were made and tested for each beam. The concrete averaged 5,600 psi in two days and 7000 psi in 28 days.

Deck placed in eight days

The deck members were placed in eight days, but with better coordination between delivery and erection they could easily have been placed in six days. The first two beams of each span were erected from the stream bed by means of two cranes, one in the bed and the other on the deck. All other beams in the span were then placed from the deck, the trailers being backed out over the beams previously placed. All units were doweled to the bridge seats.

Steel slide plates (Fig. 5), separated by copper sheets, were placed at one end of each of the 72-ft beams. One-inch round transverse tie rods were passed through the beams at all diaphragms to tie all eight beams together. The longitudinal shear joints between the beams were packed with a very dry mortar so that a load applied to any one beam would be transferred to adjoining beams.

The substructure was built by Brann & Stuart Co., Philadelphia, under the supervision of Albright & Friel, Consulting Engineers, of Philadelphia. The contractor for the deck was Edward A. Daylor Co., Inc., Coatesville, Pa. The superstructure was built under the supervision of E. J. Kinney, County Engineer, and J. B. Long, M.ASCE, Consulting Engineer.

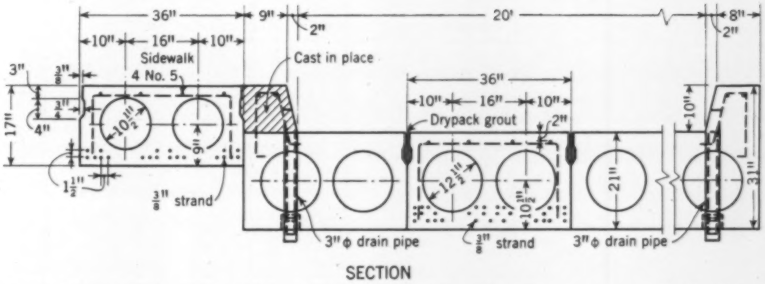


FIG. 4. Cross section through deck shows how 45-ft end spans were assembled. Note use of special sidewalk beam and special curb beam used at sides of 20-ft roadway.

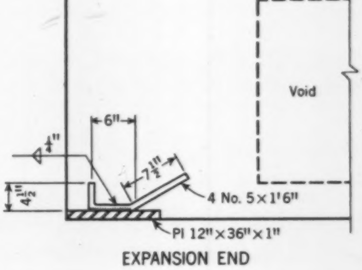


FIG. 5. Expansion end of each beam is provided with steel slide plate, which rests on another steel plate on pier, with copper sheets between the plates to prevent them from freezing by corrosion. Fixed ends of beams are doweled to piers.

Source of subgrade material must bear economic relation to other pavement courses placed over it. Here Marion power shovel loads Caterpillar bottom-dump truck at borrow pit for Maine Turnpike.

Placing of

J. D. WELCH, A.M. ASCE

Provision of optimum moisture with uniform blending is key to proper compaction of selected subgrade. Addition of water and blending can now be achieved in one operation by equipment such as this Trav-L-Plant, manufactured by Seaman-Andwall Corp., here shown preparing subgrade for AASHO Road Test.

To insure rapid progress without sacrificing quality on the new federal road program, select subgrade materials must be employed for the foundations of pavements. Select subgrade materials may be known by other names, such as special subgrade material, select subbase soil, or select borrow material. Regardless of the name used, we mean the material placed on the natural embankment soil, or on the template grade in cut sections—where the actual design of the foundation for the highway pavement begins. The special considerations here discussed apply to the material content, selection, placing, and treatment required to provide an economical heavy-duty pavement that will be relatively maintenance free.

Regardless of the pavement design chosen, the function of the select subgrade material is to provide adequate bearing for the full frequency and magnitude of the traffic load, to permit the drainage needed under the pavement, and to give adequate protection from frost heave and spring thawing in the particular geographic region under consideration.

The purpose of a select subgrade material may be defined as the provision of an economical foundation performing the three functions noted above, thus effectively distributing the pavement loads to the inherently weaker soils below, so as to withstand the anticipated attacks of nature and of man. If the foundation is not adequate, it is a truism that the pavement will not be adequate—regardless of the greater strength of the materials in it. The economic factors involved are evident when it is considered that the select subgrade materials replace the more expensive pavement materials at depths where the great supporting properties of the latter are not necessary.

With regard to the character of the select subgrade, its functions indicate the need for a granular soil, or materials of a granular nature. The specific range of gradation is dependent on the bearing capacity, drainage, and frost resistance of the pavement design chosen. Either a pervious or an impervious function for the select subgrade may be achieved by the granular gradation. In addition to the specific pavement design, the drainage requirements under the pavement are a function of the over-all roadway-section design as well as of the local climate.

The source of the subgrade material must bear an economic relation to the other pavement courses placed over it. Since its purpose is to replace higher grade materials without sacrificing pavement function, the economics of the problem is based on geographic availability of natural or manufactured sources. Transportation may be a factor in the economic considerations if there is no local natural source. Similarly, processing of natural material from local sources or the substitution of artificial material may be decided on to achieve uniformity and the desired functional characteristics. Examples of manufactured or substitute materials that might be considered are crusher-run sandstones and processed industrial slag.

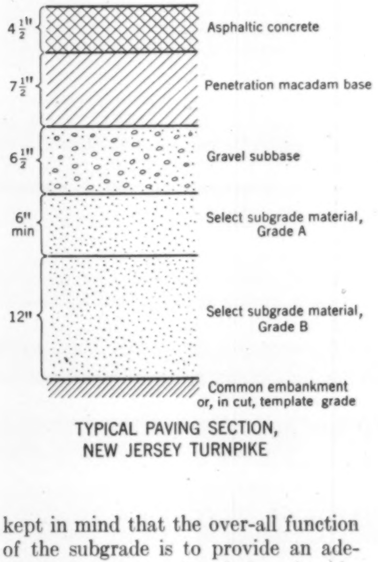
Placing the subgrade materials

After all the various factors—economic availability of suitable materials, design of the pavement section, desired functions of the material, and natural soil conditions to be encountered on the project—have been correlated in choosing the select subgrade material, the next step of course is placement. It should be continually

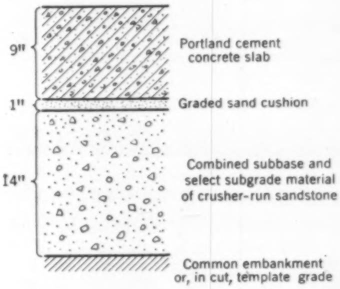
select subgrade materials—heart of the highway

Chief Soils Engineer, Howard, Needles, Tammen & Bergendoff, Consulting Engineers, New York, N. Y.

FIG. 1. Subgrade is designed to supply as firm a foundation as possible for pavement, regardless of whether the latter is bituminous or concrete.


4½"
Asphaltic concrete
7½"
Penetration macadam base
6½"
Gravel subbase
6" min
Select subgrade material, Grade A
12"
Select subgrade material, Grade B
Common embankment or, in cut, template grade

TYPICAL PAVING SECTION,
NEW JERSEY TURNPIKE


9"
Portland cement concrete slab
1"
Graded sand cushion
14"
Combined subbase and select subgrade material of crusher-run sandstone
Common embankment or, in cut, template grade

TYPICAL PAVING SECTION,
WEST VIRGINIA TURNPIKE

kept in mind that the over-all function of the subgrade is to provide an adequate pavement foundation in the completed structure. The irregularity or grade tolerance of the ultimate surface of the select subgrade should be limited in such a way as to contribute, in the placing of subsequent courses, to the ultimate smoothness desired.

Where the design for the select subgrade material so dictates, layered construction may be necessary to assure uniform results in density and content as well as in grade. The importance of achieving uniformity in content and grade can be appreciated when it is realized that in most cases the transition from the embankment or the cut cross-section to the more refined pavement cross-section is achieved within the subgrade course. To further assure the realization of the design foundation, the quality of the select subgrade material must be continually observed by selective sampling on the grade. Such sampling must be in proportion to the quantity placed and the indicated uniformity, regardless of whether the material is from a natural source or from a processing plant. The samples are of course tested and analyzed to find out how close their properties are to those specified.

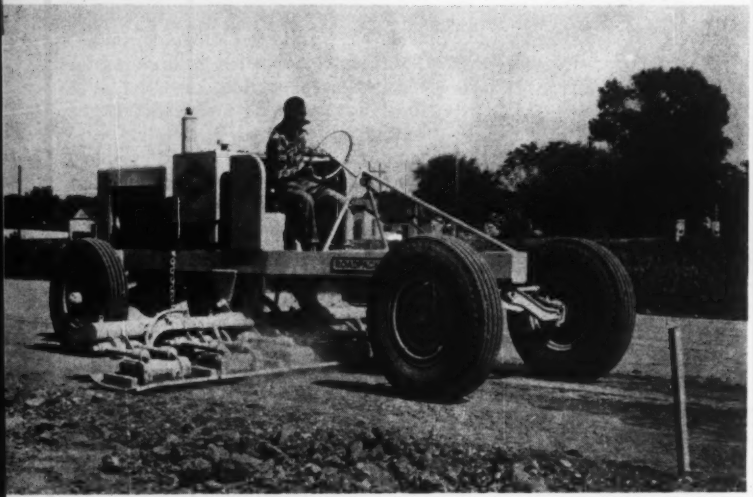
Method of placing

The method of placing the select subgrade material should be such that it will not hinder the over-all progress of construction. Normal grading operations employing modern high-speed earth-moving and spreading equipment suitable for granular soils are generally adequate. The specific nature of the equipment would be dictated by the source of the material, type and length of haul, and most productive method of placement.

It is entirely possible that the gradation of granular materials from economic sources would be such as to result in segregation when the materials are handled by normal earth-moving equipment. In that case special spreading or blending operations would be necessary to achieve uniformity. An example of such special placement methods would be the use of spreader boxes, such as the Jersey Spreader, mounted on crawler tractors, and fed by end-dump trucks. An example of blending on the grade to eliminate segregation is windrowing and spreading with motor graders.

Another special treatment that would achieve the desired blending would be the use of traveling pug-mill-type mix-

Final field-control compaction operation is test rolling to locate any soft spots. This test rolling is generally best achieved with double coverage of heavy rubber-tired roller like this Bros "super compactor." Tire pressure of 150 psi is recommended for this use.



To prepare road base for paving, tamping and vibrating action is exerted by six hydraulically driven 420-lb shoes on new Lima Roadpacker. Machine compacts equally well traveling forward or reverse, and vertical packing action prevents "shoving."

Granular soils of type used for select subgrade material require dynamic and vibrational loads for compaction. This new Terrapac vibratory roller (Type CH-30) by Vibro-Plus Products, Inc., is seen working for contractor Carl Bolander & Sons Co. on the Minneapolis Airport, Minnesota.

CATERPILLAR

ers. The selection of the special treatment called for to assure uniformity is dependent on the character and magnitude of the segregation or non-uniformity produced in the initial placing operations.

Following placement comes compaction. This should not be considered as just the movement of compaction equipment over the layers, but rather a combination of proper handling, placement and treatment, to achieve the desired maximum densities. Thus the preparation of the material for compaction is a phase of placement, the end result being proper consistency and uniform moisture distribution. The aim of compaction is to provide the densest uniform condition practicable in place, by the most modern construction equipment and operations available, so as to secure the greatest bearing capacity of the material as a foundation for the pavement.

Compaction and densification are necessary to prevent future subsidence of the pavement from additional densification after construction by traffic loads and vibrations. The great care taken to place a pavement to exact grade, with restrictive tolerances, is not warranted if inadequate foundations permit subsequent movement and destruction of the smooth riding surface.

Evaluating compaction

In evaluating compactive effort and the resulting compaction, some standard or measure must be established on the basis of a laboratory analysis employing a predetermined standard compactive effort. In applying the standards of laboratory compaction to field compaction, the field compaction is generally stated as a minimum allowable percentage of the laboratory maximum, expressed as a percentage of compaction, a percentage of relative density, a percentage of relative compaction, and so forth.

It is known, however, that the compactive effort in the field differs from that in the laboratory with the result that the optimum moisture content for field compaction may differ from the optimum for laboratory compaction. The type of the compaction equipment, the thickness of the layer being compacted, as well as other conditions of field compaction—all are factors in this variation. Therefore sufficient time should be provided at the beginning of construction for the preparation of a field test section to establish the field standards for compactive effort. In this field test section, the thickness of the layer may be varied as well as the moisture content, and the number of passes and unit weights of the compactive equipment. Although such field tests involve an extra effort, they will ultimately save time and improve progress, when all concerned clearly understand the field method to be employed and the effort necessary to achieve the desired degree of density.

In achieving adequate compaction by whatever equipment is best suited to the material and the progress schedule, a firm base for the compactive effort to react against must be provided by the common embankment, or the template grade in cut sections. Therefore the upper parts of embankments, or the template grade in cut sections, must be thoroughly compacted.

Two primary considerations in the preparation of select subgrade material for compaction are of course moisture content and uniformity of material. The material must be at or near the optimum field moisture content to effectively achieve the desired densities. The aim of proper moisture content is generally achieved by adding water and employing some method of mixing or blending to distribute it uniformly throughout the full depth of the layer being treated.

Addition of water and mixing can now be achieved in one operation with some of the modern equipment employed in highway earthwork construction. The time spent in proper conditioning of the subgrade materials is most advantageous as it drastically reduces the time necessary for compactive effort to secure the desired degree of density. Without mixing or blending to assure uniform distribution of moisture, any given amount of compactive effort will result in non-uniform densities in proportion as the moisture contents diverge from the optimum. Thus the addition of moisture at the surface of a layer, without blending, does not provide the uniformity needed in the pavement foundation.

When the select subgrade material is too wet, as happens in many cases, it must be aerated by construction equipment such as heavy-duty disk harrows. It should be pointed out that the area of preparation and placement of a select subgrade should be sufficiently extensive to permit proper deployment of the compactive equipment so as to produce the optimum compaction for the potential of the equipment, without delaying the over-all construction progress.

Granular soils of the type used for select subgrade materials do not respond favorably to a kneading compactive action, such as that provided by sheepsfoot rollers, but rather require dynamic and vibrational loads. The magnitude of the loads of the compactive equipment is restricted only by the limitations of the equipment itself, and not by the character of the material, as is the case with clay soils.

Compaction equipment—two types

Equipment employed in achieving field compaction can generally be divided into two categories—rubber-tired rollers and vibrational units. Other forms of compaction equipment would be supplementary to these two main types.

Rubber-tired rollers are of many designs and styles, but they generally consist of either the multiple-truck-tire roller or the heavy-duty roller known as the "super compactor." The multiple-truck-tire roller may be either self-propelled or pulled by other construction equipment, while the heavy "super compactor" on large-diameter tires must be pulled by other equipment. The suitability of these various types of rubber-tired compaction equipment is dependent on the particular method of operation and scheduling employed by the contractor.

Vibrational compaction equipment is generally of three types, in which the vibrating element is a steel roller, "pans" or plates, or rubber-tired rollers. The advantage of vibrational compaction equipment results from the fact that granular materials are susceptible to densification by vibrational frequencies of the proper magnitude set up by equipment of relatively lighter weight. This lighter weight results in greater maneuverability. Here again, the exact type of the vibrational equipment, and the relative advantages of vibrational equipment and rubber-tired equipment, are dependent on the character of the construction program adopted for the project.

After compaction has been completed to the desired densities, it would generally be desirable to compact the top surface of the select subgrade material with a steel flat-wheel roller, to eliminate surface irregularities produced by other compaction equipment and to provide a true and uniform surface for subsequent paving work.

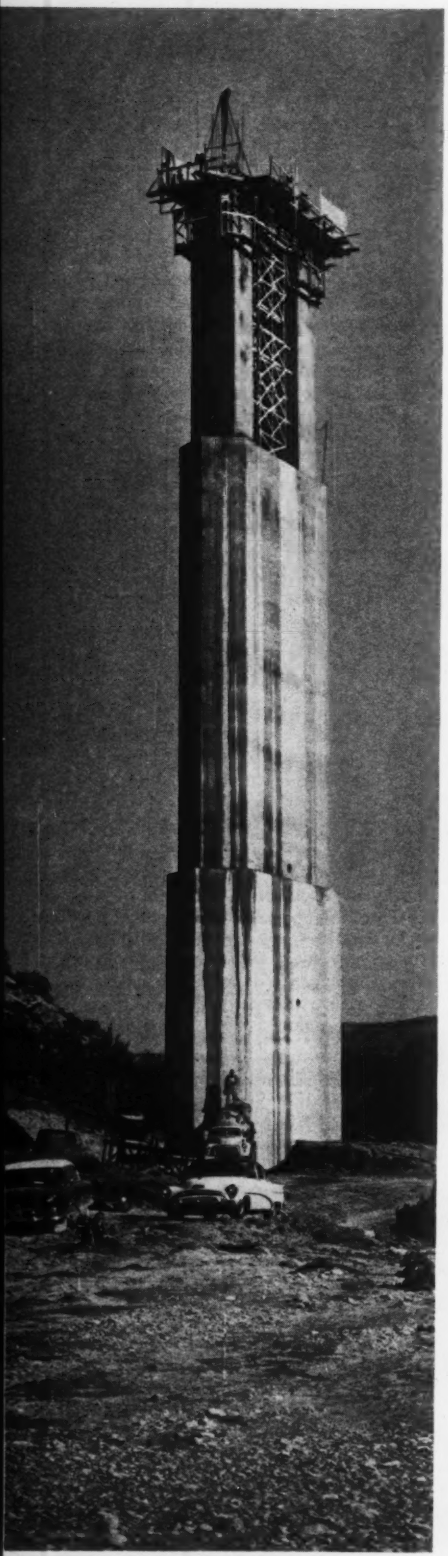
Various means of control must be employed to assure an adequate pavement foundation. Sampling and testing of the material to determine its content and gradation have been previously discussed. During placement and preparation, samples are taken for the measurement of moisture content to facilitate compaction. When compaction is completed, it is desirable to make field density tests to determine the degree of compaction achieved. The equipment for determining field density measures the weight and moisture content of a selected quantity of material and then measures the in-place volume of the same material.

Full control of the whole process of subgrade placement cannot, however, be effected just by sampling, testing, and analyzing. Some form of reliable visual control must be exercised. It is not possible to test every square yard placed for its material content, moisture content, and density. Therefore the inspectors must gain a visual "feel" for these factors.

In this visual inspection and evaluation, the ability of the inspectors can generally be based on a thorough initial testing program which will provide a basis for judging what is or is not acceptable in the light of the specified standards. Various simple aids can be employed to correlate the actual construction with the desired results. Aids that can be utilized proficiently with a minimum of training include a visual grain-size determination, staining on the hands from the fines in a moist granular soil, the moisture content by feel and hand-ball compaction, and field compaction evaluation by the action and effort of the construction equipment.

The final field control operation would be a test rolling for the purpose of locating any soft or unstable areas, to assure that the select subgrade provides an adequate foundation for subsequent pavement construction. This test rolling is generally best achieved with a double coverage of a heavy rubber-tired roller of the type commonly known as a "super compactor," loaded to at least 50 tons, such that a 25,000-lb load is carried on each wheel. Because of the close proximity of the imprint areas from the tires of such a roller, it is possible for smaller areas of instability to be bridged by the roller without giving any visual indication of their presence, and therefore it is desirable for the tires on such a heavy-duty compactor to carry 150 lb per sq in. of pressure.

The fulfillment of the "Grand Plan" for federal highways will require the full ability and ingenuity of the civil engineering profession. Although the proper choice and placing of select subgrade material is only one of a multitude of factors that enter into the solution of the problems facing us, it is of sufficient significance to aid greatly in the successful completion of this gigantic task. The new highways must not only conform with the latest standards of superhighway design and construction—or even with standards yet to be conceived—but they must also provide service, with a minimum of maintenance, that is worthy of the astronomical investment being made in them. The use and proper placement of select subgrade material is one of the "tools" needed to achieve this end.



EXTRUDED CONCRETE

for bridge piers

C. M. DAVIS, M. ASCE

Chairman, ASCE Construction Division; Consulting Engineer, Fort Worth, Tex.

Soon after the start of World War II, in 1943, one of the engineers of the Portland Cement Association came to me with the question, "How can two immense bridge piers be built without the use of critical materials for forming?" Perhaps he thought I knew where to find several hundreds of thousands of feet of suitable used lumber, because the War Production Board would not permit the use of new lumber beyond about 150,000 fbm. I couldn't be of any help to him at all on that score, but his inquiry did bring out a latent desire I had had for some ten years to attack the same problem in another manner.

For a number of years I had been engaged in the design and construction of grain elevators by the slip-form method—now a common practice. In 1931 I had built two small bridge piers by a variation of that method. It would be more appropriate to use the term "moving form" rather than "slip form" for this method. On the first bridge job I dubbed this method the "extrusion process" and called the product "extruded concrete" as the term most nearly conveying the idea of molding by a continuously moving form.

My first approach was to the engineers who were to design the desired piers. I said I could do this job by such a method using not more than 25,000 fbm of form material. My suggestion was considered and rejected as an impossibility on the basis that, while thin walls such as those in grain storage structures could be built that way, thick walls could not because the masses of green concrete would slump out from under the forms.

Pecos River Highway Bridge has main piers 210 ft high built by extrusion method in 1955-1956. Texas Highway Dept. designed and built it with Whittle Construction Co. contractor.

My next approach was through a prospective bidder on the structure, who luckily had as a superintendent a man who had been my superintendent on some other work of this type. With his recommendation, the bidder accepted the challenge, and the contractor's resources convinced the designing and supervising engineers and the owners. This structure was the high single-track bridge of the Southern Pacific Railroad Company over the Pecos River in West Texas, shown in accompanying photographs. The two high piers of this bridge rise some 280 ft above the river level and support the track 325 ft above the pier tops.

Each of these piers contains about 6,500 cu yd of concrete, is 33 × 55 ft in cross section at the foundation and 11 × 33 ft at the bridge seat. Each is hollow to within some 20 ft of the bridge seat, the wall thickness being reduced from 8½ ft at the bottom to 3½ ft at the top. Using the extrusion process, these piers were built without difficulty and with such dispatch that they were finished 100 days before the contract completion time. I designed the forms and supervised their construction and use for the contractor.

Since that time I have used this method on the construction of tall piers for four other bridges. To date these are the only applications of this system on high piers, though the process is now being used on a series of lower piers for the approach to the Carquinez Strait Bridge near San Francisco. (See article by Leonard C. Hollister, M. ASCE, in Civil Engineering, January 1957, pp. 54-57.)

We have revised our ideas of how concrete behaves in the early stages of setting. For some reason it was set forth in the dim past that 28 days was the minimum time that forms should be kept on to support green concrete. Gradually this time was reduced to 7 days. In the extrusion process as used on tall piers, this time has now been reduced to about 2 hours. In 2 hours concrete will support itself and the load of concrete, forms and operations above it.

This ability of the concrete is due to removal of excess mixing water and the consequent cohesion of the aggregate particles. It is not due to setting of the cement because it is known that the initial setting time is perhaps 2½ or 3 hours.

We must revise our ideas of concrete proportioning as to coarse aggregate, fine aggregate, cement, and water. My experience with concrete dates back about as far as modern concrete—and I'm not so old either. Sixty years ago all concrete experts had hydrophobia—literally dread of water. The mechanical mixer—the Smith tilting or the Cube tilting—were rare objects. The mixing board was the thing needed—a good board of 2-in. plank about as big as a present-day jitterbug floor, a pair or more of shovelers and one garden sprinkling pot with a perforated nozzle on a spout.

Rock 6 in. deep and sand 3 in. deep —both angular and sharp—were spread out on the board, and the necessary number of barrels of cement was carefully spread over the sand. (The cement came in wooden barrels, probably Bear Brand or Lion Brand from Belgium.) Shovelers then went into action by pairs, one left handed and one right handed, and how the dust did fly! After this was done twice dry, the sprinkler pot was put in action. Who could tell whether the water was added to hydrate the cement or just to allay the dust, because about the time the dust began to abate, the batch was ready to place.

Then experience demonstrated that the almost dusty mixture was no good, so gradually the hose was brought out. Mixtures became so wet that the mixing boards wouldn't hold the slush. That made the mechanical mixer necessary. Spouts and chutes took the stuff from the mixer to the form. After a pour on a windy day everything near the job was plastered.

The pendulum swung back. Poor structures made it evident that too much water was being used. Out of this came the experiments by Duff Abrams, M. ASCE, and gradually the early theory of the water-cement ratio emerged.

It never was the intention of the proponents of the water-cement ratio that a harsh mix should result, but the high strength gained by tests on concrete with a low water-cement ratio caused many an engineer to use too harsh a mix, and in some cases the results were no better than those obtained with the slush of the preceding era. With the harsh mixes came a flood of admixtures to improve workability. The claims made for some of them would have made Barnum blush for shame. Some had the merit of attaining more workability, but on final analysis the cost was out of proportion to the gain. A higher cement content would have provided the same workability at no higher cost while giving a far better product.

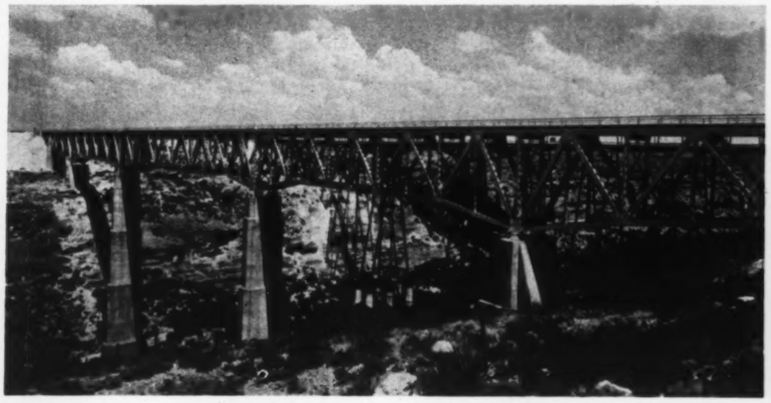
The theory of the water-cement ratio was about the first serious attempt to apply a scientific approach to the problem of good concrete. It is now recognized as basic. However, I have never found a logical reason for the truth of the theory. I can think of no reason why water weakens the resulting mixture except by reducing the density. I cannot believe that an excess of water in the mixer—producing a slump of 5 in. as compared with 4 or 3—necessarily means that the concrete in the bridge or building will be weakened.

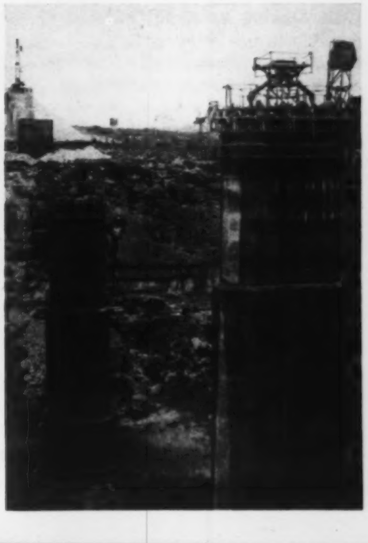
It seems to me that the water-cement ratio, instead of being applied to the concrete as it leaves the mixer, should be applied to it after it has been treated in the same manner as that in the finished structure. Similarly, samples for test specimens should reflect the same conditions, as nearly as possible. The water-cement ratio of the concrete at the time of apparent initial set should govern. Up to that time the mixture is constantly losing water by leakage, evaporation, and absorption in forms.

If it were practicable to apply pressure to the concrete after placing, so as to squeeze out the excess water, or if any other method of extracting the excess water could be applied, then regardless of the amount of water put into the mixer, a final uniform (within small limits) water-cement ratio would be obtained.

The effect of removing excess water is particularly evident in concreting by the sliding-form process as used in grain-bin construction. There the walls are about 7 in. thick, and the forms are moved upward at such a rate that they support the concrete for a period as short as 2 hours. Not only is that 7-in. wall of concrete stripped of the forms in 2 hours but an additional load is placed on it. Were it not that almost

Initial application of extrusion process on high piers was on Pecos River Bridge of Southern Pacific Ry., built in 1943. Piers 285 ft high carry single track 325 ft above river near Langtry, Tex. Modjeski and Masters were consulting engineers and Brown & Root contractor. Note setbacks and forms at top of piers in construction view, at right.





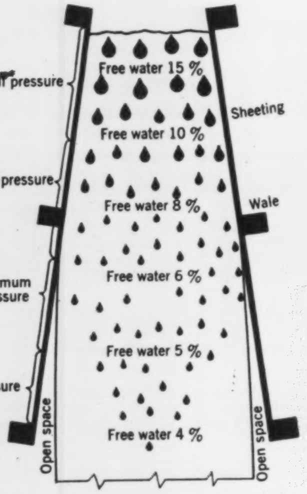
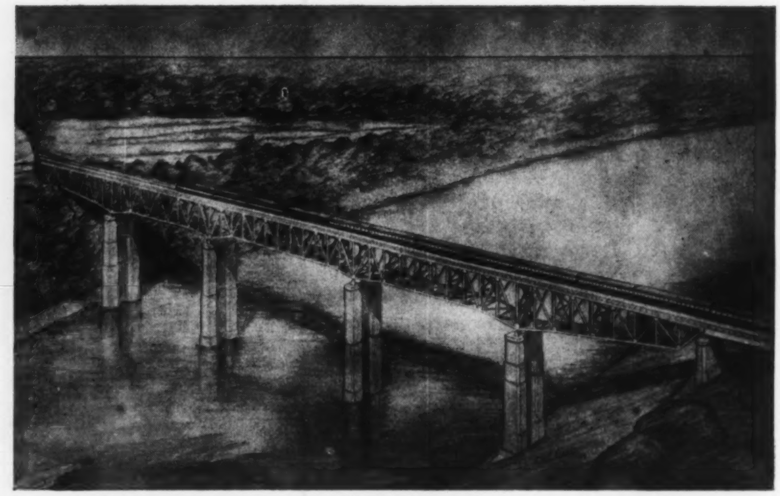


FIG. 1. Exaggerated section through pier slip form shows how excess water is pressed out of concrete before it must be self-supporting—about 2 hours after pouring.



In 1947, piers 240 ft high were built by slip form for Cumberland River Bridge of Southern Pacific Railway near Burnside, Ky. Forms were jacked up and concrete poured at rate of about 10 in. per hour, or at least 16 ft per day of continuous pouring. Modjeski and Masters were consulting engineers, Massman Construction Co., contractor.

all the excess water has been lost, the unsupported fresh concrete would collapse. Vibration causes excess water to rise to the surface, where it flows off or can be removed. Vibration also removes a large part of the entrapped air, and as a result the concrete increases greatly in strength.

In mixing for extruded concrete, enough water can be put into the mixture to make it readily workable, so that it will flow into place in narrow congested forms without much puddling and tamping. Normally so much excess water is removed after the concrete is placed that the desired strength of a stiffer mix will be attained without question. Isn't it probable that such loss of excess water—which cannot occur in the tight forms used for test cylinders—accounts for a part of the much greater strength shown by cores taken from cured concrete than by test cylinders of the same mix?

In making extruded concrete it is possible to use concrete of any consistency. It is better, however, to use enough water in the mix to make compaction easy. The excess water is removed and flows down between the partially hardened concrete and the form, not only providing lubrication to facilitate form movement, but also supplying water for smoothing the concrete by floats to give a smooth, even surface. Certainly the water that percolates out immediately after placing should be deducted from the amount put into the mixer and not considered as mixing water proper.

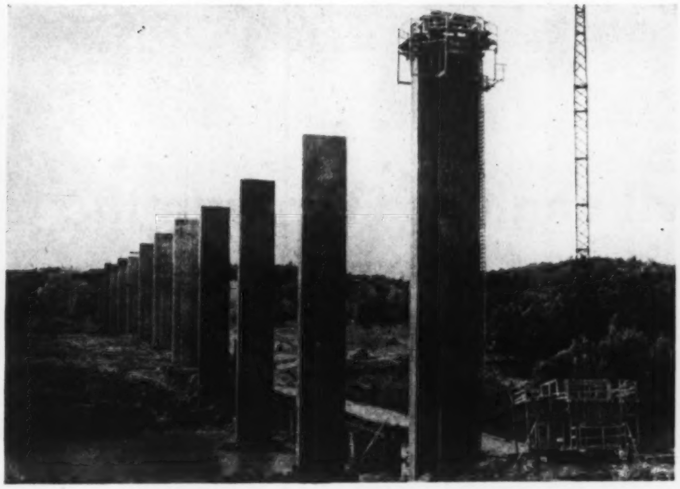
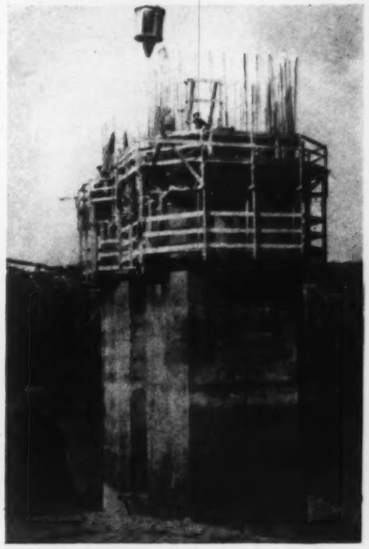
An exaggerated section of an extruded concrete wall is shown in Fig. 1. In it the batter of the form is greatly exaggerated. This section illustrates the decrease in the amount of free water in the concrete as the form progresses upward. The percentages given on the section are neither fixed nor accurate but are those considered probable.

First, the 15 percent indicated on the surface is greater than the amount initially present in the mixture because it has been augmented by water raised to the surface from lower layers by the pressure of the concrete being deposited. As the concrete is deposited on top and as the form rises, the water content of the lower layer continually decreases. The mixture is sufficiently porous for the free water to percolate through the particles to the surface, and as pressure is released by the batter of the form, this percolating water trickles down the surface of the concrete and down the form. Some of the water combines in a chemical reaction to cause hydration of the cement but this amount is relatively small in the 2 hours required to raise the form from full lateral pressure to zero lateral pressure. Usually the bottom third of the form hangs free, and it is usually possible to insert a thin metal rule upward about 6 or 8 in. between the form and the concrete. That is the safety factor in case vibration or the presence of entrapped free water should cause a slump.

On the basis of 6 gal of water per sack of cement we use 300 lb for each cubic yard of mixed concrete, or about 7.7 percent of the gross weight. This amount might be put into the voids in the mixture, but would be partly free water in any case, and if given the opportunity would leak out, leaving only that water which adheres to the grains of the aggregate, and which is necessary for the chemical reaction during hydration of the cement.

The free water is that which, in the extrusion process, flows out and down between the concrete surface and the form as the form moves upward. This escape of water does not occur with fixed and tight forms, with the result that the strength of the concrete is reduced. If the excess water is not eliminated from extruded concrete during the time required to move the forms sufficiently to leave a space between the lower edge of the form and the concrete, there will be a slumping action in the concrete mass and eventually a "fall-out" below the form. If no fall-outs occur, a concrete with a near minimum water-cement ratio is assured, regardless of the amount of water used initially in the mixer. As stated previously, the self-supporting character of the concrete is due to cohesion of the particles rather than to setting of the cement even though a slight setting takes place as soon as moisture comes in contact with the cement particles.

There is a definite relation between the speed at which the form is jacked upward and the cohering-setting action of the concrete mass. Since temperature is a vital factor, the rate of rise is to some extent dependent on the ambient temperature. In spite of the generation of heat in the mixture during setting, in cold weather there is danger of a

Two other structures on which slip forms were used for pier construction are Whitney Lake Bridge for Missouri-Kansas-Texas Railway near Whitney, Tex., built in 1951 (above, left) and White River Bridge on Highway 13 near Branson, Mo., built 1956-1957. For former, Modjeski and Masters were consulting engineers, and Massman Construction Co., contractor. Latter was designed by Corps of Engineers with Sverdrup and Parcel, engineers, and Guy H. James Constr. Co., contractor.

fall-out from the concrete surface well below the point where the form is free if hydration of the cement is stopped because of low air temperature. In very cold weather the form and the upper and lower scaffold can be housed in with canvas and heated.

In hot weather, hardening may take place so rapidly that concrete may stick to the forms. This is called a "pick-up," a prevalent condition in thin sections and the cause of much trouble. It scarcely ever happens on thicker sections such as bridge piers, but appears occasionally as a surface adhesion causing a series of laminated checks, or in bad cases a falling off of the surface concrete.

As the form progresses upward, it is usual to finish the concrete surface with floats as it clears the forms. At this time—usually four or five hours after pouring—the concrete has sufficient plasticity to respond well to the floats. All form marks and flaws can be removed, and floating gives that crystalline surface so necessary for watertightness and cleanliness. A wood float is the proper tool, but where required a steel-trowel finish can be obtained without the application of any mortar, and it is also possible to apply white or color as desired.

Curing can be attained by spraying with water or curing compounds. A continuous spray on the surface, provided by a perforated pipe hung about 6 ft below the form, is ideal.

The most difficult feature of extruded concrete is the maintenance of verticality, especially where the section is small. The cause suggests the remedy. If the form is accurately built and maintained in precise position, there is but one way for it to rise and that is straight up. If it does not do so, then it is either not properly battered or it is out of level. There are many ways of correcting this, but what is proper in any case depends so much on the circumstances that I would not venture to give any general remedy. That is very much a matter of experience. This is one method of construction that should not be attempted without experienced supervision. Experience with large thin-walled structures such as grain elevators is not applicable to thick-walled structures of small area.

In ordinary weather a rise of from 6 to 12 in. per hour is permissible. With the addition of calcium chloride on one construction job we were able to average a rise of 16 in. per hour with a constant air temperature of 50 deg F. This makes a daily rise of from 12 to 24 ft. Usually I predict 16 ft per day, which if maintained shows fast progress. On the Whitney Lake Bridge we actually completed two piers 100 ft high in 6 days by working on both piers alternately. A completion rate of 3 days for a 100-ft pier is good progress.

Up to the present time all the piers built have been designed in stepped sections which at first required considerable delay at each setback. For the Whitney Bridge, I was able to design a form which could be changed in section without any delay, and on the White River Bridge I arranged the form so as to require only a few hours of delay at two of the three setbacks.

Given a design that would require no delay at all, we would have no construction joints or interruptions—which are relatively costly.

The method is economical in that but little material is required for forms, and the form is constructed on the ground, not in the air. Reinforcing is placed as the form progresses. The verticals are placed in accurate position by threading them through templates attached to the form, and the joints are staggered as desired. The horizontal steel is laid on top of the concrete surface at the proper level. It is not even necessary to wire the rods to hold them in position. A further point is that the concrete actually surrounds the entire bar, and there is no problem of steel coming against steel, or as so often happens of voids caused by wire wrappings. Concrete is placed at foot level in thin courses—not deposited through a maze of rods.

Finally, the process is a cost saver. Labor is greatly reduced since relatively few men are required. Even though a large amount can be saved on the type of pier construction used in the past, probably a greater saving could be realized by a design with closer pier spacing and shorter spans. So far it appears that the saving on bridge piers is 25 to 30 percent. The saving in time is probably one-third.

(This article is based on the paper presented by Mr. Davis at the ASCE Jackson Convention, before the Construction Division session.)

The civil engineer through the ages:

In the February issue Dean Finch probed the misty records of Egypt's earliest construction engineers as far back as 3000 B.C. In this article he brings the record up to the era of obelisks, about 1500 B.C.

IV. Uni, hydraulic expert

From the "mists of antiquity" emerges the shadowy picture of one of the world's first hydraulic engineers. In a tomb at Abydos of about 2500 B.C. it is recorded that one Uni held, among other offices, that of "Superintendent of the Irrigated Lands of the King." Later, under King Mernere we read that his father's faithful servant, Uni, was appointed Governor of the South and commissioned to open a passage for boats at the First Cataract of the Nile, an undertaking which also received attention under later rulers.

It is extremely difficult to secure an adequate picture of early Egyptian irrigation. Practically no rain falls in the Nile valley proper. The annual "inundation," caused by rain on the upper tributaries, begins in June, reaches a level of 16 to 23 ft above low stage in September, and is over in November. By March, when the river is far below its banks, no crops can be grown except by irrigation of some sort.

In the delta, canals early brought water to many areas. Favorable low areas in the upper valley may also have been supplied by canals, while in higher natural basins some of the flood waters may have been held back by barriers for later use. It is conjectured that an extensive and quite effective system of such irrigation works had been developed by the Pyramid Age. Certain it is that productivity must have been high to permit the withdrawal from agricultural pursuits of the 100,000 men engaged in building the Great Pyramid. But anything approaching modern irrigation by flooding seems to have been entirely out of the question. Even today full "perennial" irrigation is still to be achieved in Egypt. The *shadoof* or well-sweep, probably employed in ancient times, is still in use to raise water from the canals and the river.

On the basis of a similar comparison, Uni's work at the First Cataract does not imply canal construction with a lock—a device not known until almost forty centuries later. Undoubtedly Uni merely removed projecting rocks and boulders to provide a passage through which a boat could be pulled against the swift current of the river.

References to a canal from the Nile to the Red Sea also occur and, while vague and shadowy, need not indicate more than a modest channel through which could pass the smaller boats of the day. King Necho in 600 B.C. is credited with connecting the Nile and the Red Sea by canal. When such a canal is neglected, the desert sands quickly claim back their own, and this probably accounts for the various references throughout Egyptian history to the cleaning out and restoring of such a channel.

V. Ineni and Senmut, obelisk experts

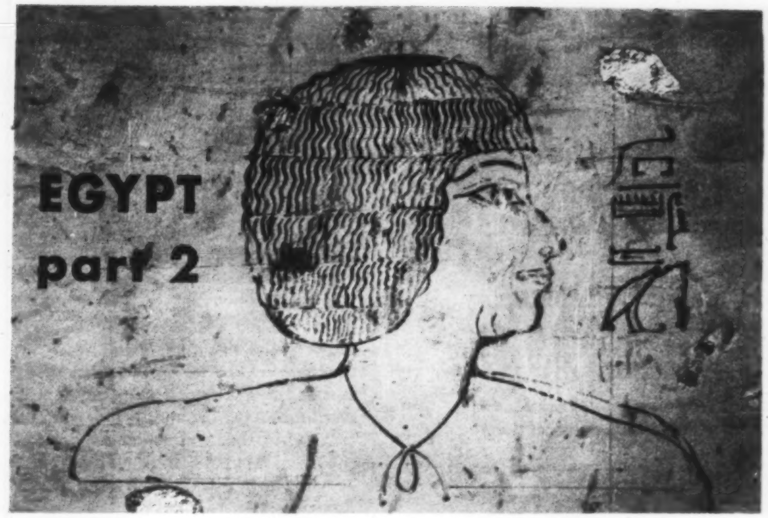
While no essentially new device or method of construction appears to have been developed in the two thousand years which elapsed between the Pyramid Age and the Persian conquest of Egypt, what we now call architectural style did change. Engelbach remarks that the quality of Egyptian masonry reached its peak in the Pyramid Age and steadily deteriorated thereafter. Massive walls became merely two exterior shells filled with rubbish.

Egyptian builders were also notoriously weak in foundation construction, a fatal defect in areas of valley silt and mud. Columns often rested on a single layer of small stones, suggesting that an undue emphasis on speed may have encouraged shoddy practices. Such weaknesses were serious, especially in view of the lack of masonry headers. Foundation failures were frequent but seem to have taught no lessons. Such failures were perhaps the origin of the Biblical advice not to build one's house upon the sand.

The advent of the obelisk raises some additional questions as to the methods of quarrying and erecting great monoliths. Ineni and Senmut were two top ranking nobles and Chiefs of Work in the Obelisk Age. The former's active life began about 1550 B.C. in the Empire Period, the military age of great conquests. It extended into the reign of young King Thutmosis I who, with Dowager Queen Hatshepsut, managed a quarrelsome co-regency. Unable to inscribe his name on his works, this early master builder had no inhibitions when he came to plan and embellish his own tomb. Ineni records his titles:

"Pasha, Count, Chief of All the Works in Karnak, Controller of the Double Houses of Silver and Gold, Sealer of All Contracts." He states, "I inspected the great monuments which the King made . . . a great hall of fine Ayan limestone . . . a great doorway of Asiatic copper . . . the erection of two obelisks, and built a boat 207 ft long and 69 ft in breadth for transporting these obelisks." In closing his in-

EGYPT
part 2



J. KIP FINCH, M. ASCE

Dean Emeritus and Renwick Professor of Civil Engineering, Columbia University, New York, N. Y.

Senmut, obelisk builder and chief adviser to Queen Hatshepsut, is seen in a contemporary sketch. One of his obelisks still stands at Karnak. Courtesy of the Metropolitan Museum of Art, New York.

scription he did not err on the side of modesty:

"I became great beyond words. I will tell you about it, ye people. Listen and do the good that I did—just like me. I continued powerful in peace and met with no misfortune; my years were spent in gladness. I was neither traitor nor sneak and I did no wrong whatever. I was foreman of the foremen and did not fail. . . . I never hesitated, but always obeyed superior orders . . . and I never blasphemed sacred things."

As Engelbach (from whose fascinating small book, *The Problem of the Obelisks,* these notes are taken) remarks, "If Ineni handled oriental labor for forty years without blaspheming, it was not the least of his achievements."

About 1500 B.C. Queen Hatshepsut secured full control of the throne. One of her obelisk experts, Senmut, left inscriptions in his tomb similar to those of Ineni. He records:

"I was the greatest of the great in the whole land. . . . The labor of all countries was under my charge. . . . I was a noble who was obeyed. Moreover I had access to all the writings of the prophets; there was nothing which I did not know concerning what had happened since the beginning."

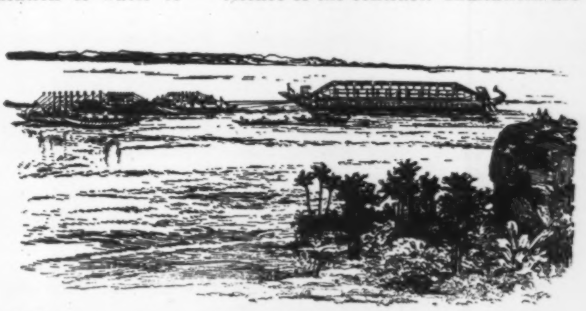
He then sends echoing down the corridors of time a message to "all living men on earth," when they see his statue, to say the usual prayer for his *ka* or double.

Not only was Senmut one of the two or three top nobles of the Queen's court, tutor of her daughter and leader of an expedition into Punt (Somaliland), but he also superintended in person the quarrying, transportation, and erection of two obelisks, the tallest attempted up to that time, which marked the Queen's jubilee. The one that remains is 97½ ft high.

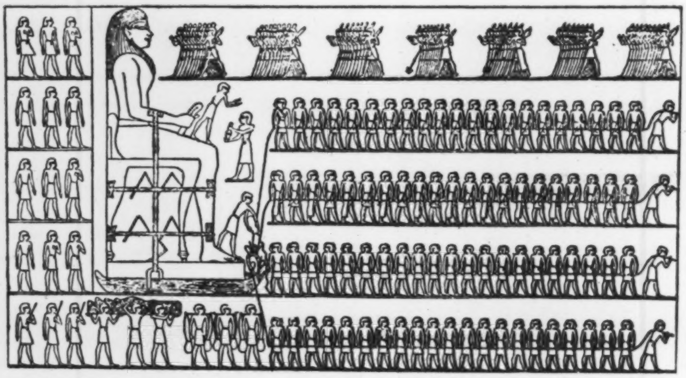
On the rocks at Aswan, the site of the granite quarries, it is recorded that "Senmut came to conduct the work of the two great obelisks. . . . It took place according to that which was commanded." A relief shows the transportation of the two great shafts down the Nile. They were placed end to end on a huge barge towed by 27 galleys which were propelled by 900 oarsmen. The first step—quarrying—and the last step —erection—were however not described. It is stated that the two shafts were quarried out in seven months.

At Aswan there still remains an unfinished obelisk, the greatest ever attempted, the quarrying of which was abandoned when a flaw developed. While it would appear that the ancient method of "fire-setting" (heating followed by the application of water to cause sudden contraction and shattering) was used to uncover sound rock, it is evident that this huge shaft was to have been taken from its bed by hand channeling—"bashing" as Engelbach calls it. In this process the granite was pounded with hand-size balls of harder diorite.

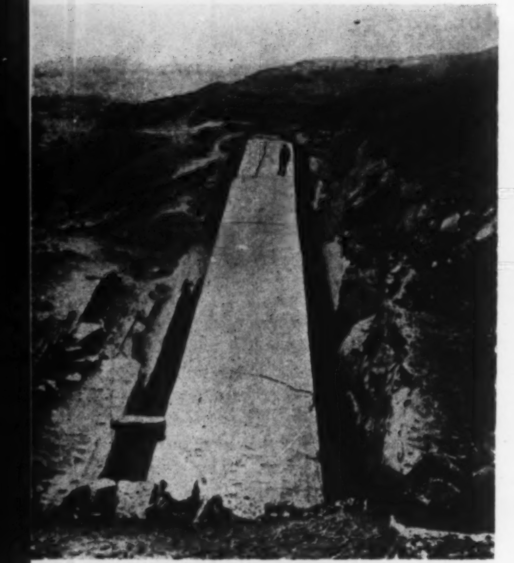
The channels, some 2½ ft wide, around the 300-odd-ft perimeter of the shaft show corrugations about one foot wide. Engelbach pictures relays forming a continuous line of workers, one every 2 ft, alternately facing each other, pounding to the right, and then shifting and pounding to the left. The seven-month quarrying period he regards as credible—he made some trial runs. He remarks that "a more efficient method could hardly be imagined," that is, under the conditions of the time, with no metal tools suited to hard rock, with labor unlimited, and with "time the essence of the contract." Indications are



Queen Hatshepsut's twin obelisks were transported from Aswan down the Nile 150 miles to Thebes. Both obelisks were carried end to end on a boat estimated to have been 220 ft long and 69 ft wide, towed by 27 boats manned by 900 oarsmen. After Breasted ("Ancient Times," Ginn & Co., New York, 1916), restored from a wall relief in the Queen's temple at Thebes.



Egyptians hauled a statue about 22 ft high by manpower (172 men) on a sled which appears to have been pulled on an oiled track of logs dressed on one face. After Breasted.



Great unfinished obelisk lies in quarry at Aswan, just as abandoned when a flaw developed in it. Hand channeling method is explained in text. After Engelbach.

not lacking that such a long slender shaft, which could not be wedged without introducing dangerous stresses, was undercut in the same way to free it from its bed.

When we come to erection, however, hints or evidence of the methods used are completely lacking. The Queen's obelisks weighed some 323 tons, but colossi weighing over 700 tons were also handled (the twin so-called Memnon at Thebes), while the colossal statue of Ramses II is estimated to have weighed a thousand tons. Engelbach conjectures that an obelisk was moved, lower end first, up a long incline and was gradually turned into a vertical position onto its pedestal by what is substantially sand jacking, the gradual bleeding out of a funnel of sand under its lower end, allowing it to sink foot foremost, with final tipping into place with ropes and levers.

Clearly it would be out of keeping with Egyptian practice to conjure up any more complicated process, and apparently it was an every-day technique considered unworthy of special record. When we recall the fuss and effort that have marked the transportation and re-erection of these souvenirs of ancient Egypt in other countries, both in the Renaissance and in modern times, our admiration for the skill of our early forerunners in engineering, the Chiefs of Works of ancient Egypt, reaches new heights.

VI. In retrospect

Even this brief excursion into the records of the past raises a most interesting question. The tremendously rapid and promising early development of construction skills in ancient Egypt appears to have quickly reached a peak followed by a long period of stagnation, decline, and decay. Why? What are the major factors which condition or direct engineering progress? Undoubtedly no simple generalization is possible. Both in the present and in the past there are many conditions, factors, and forces which affect such progress either directly or indirectly.

Clearly a lack of what we would now regard as basic technical understanding and resources had little effect on Egypt's early accomplishments. Perhaps conditions were too easy, too favorable to offer a challenge to continued progress. With unlimited manpower and materials available close to a great transportation artery, the pattern of development seems to have been quickly set. Simple means sufficed. As we have noted, environment—topography and material resources—seems to have long exercised a vital influence on the character and scope of engineering works. In ancient Egypt the need to make use of new or substitute materials did not arise. The demand for other types of work was lacking.

Also, the Egyptian mind seems to have been completely practical and satisfied with empirical procedures. There was no science in the modern sense. The first engineer's handbook, the famous Rhind Papyrus, dating from 1700 to 1500 B.C., and actually a copy of earlier rules probably going back to the Pyramid Age, "is not a mathematical treatise in the modern sense" but simply a book of useful rules and tables. It tells how rather than asks why. It describes how to compute areas of simple figures, and the "heap" of a pile of grain. It is a record of weights and measurements. Mathematics and mechanics had their birth in the desire to explain these early rules-of-thumb stemming from experience. But mankind had to wait for this advance until the inquiring mind of the early Greeks came upon the scene.

Undoubtedly also the social order and economy which became fixed and frozen early in Egyptian history had a profound influence on the art of building. There was no challenge to change and progress. The major problems of government and religion were early answered and early incorporated into the established order. The King was deified and the economy was devoted to his service and to the support of a noble and priestly bureaucracy. The poor fellah or peasant, who made up the great mass of the people, became truly Markham's "man with the hoe," the "slave of the wheel of labor, stolid and stunned, a brother to the ox."

Engineering is basically a democratic art, an instrument of civilization destined to serve all the people. Its growth likewise demands mass support. There was no such public demand in ancient Egypt, where a small but well organized ruling class sought only to maintain the status quo.

The promise of earlier days when Egypt, building her own economy isolated from the rest of the world and making these remarkable advances, was not fulfilled in the later period of her military conquests. It came to an end with the influx of foreign invaders —the Persians in 525 B.C. followed by the Greeks, Romans, Turks, French, and English.

(*In his next article Dean Finch shifts the scene to Mesopotamia and to the records left there by builders of 750-540 B.C.*)

Empirical formula for predicting pile bearing capacity

MARVIN GATES, J.M. ASCE Chief Inspector with D. B. Steinman, Consulting Engineer, New York, N. Y.

For many years engineers have been trying to develop formulas for predicting pile behavior. The empirical formula here proposed for predicting the bearing capacity of piles represents the fruit of two years of effort. Only the results of this work are given here; the supporting data are being assembled for future publication.

More than 100 pile load-test results were analyzed for correlation. Represented were 15 drop-hammers, 7 single-acting, and 5 double-acting pile-driving hammers. The gross hammer energies varied from 4,550 to 52,000 ft-lb. The pile set ranged from 0.000 in. to 4.4 in. The distribution of pile types was as follows: steel, 73; timber, 38; precast concrete, 11; thin-shell cast-in-place, 4; pipe, 3; and composite, 1. All the pile load-test results utilized were taken from existing literature.

Based on Redtenbacher's formula, which assumes that temporary compression is a function of the resistance to penetration R, the first relationship established was:

$$R \sim \sqrt{E} \quad \ldots\ldots \quad (1)$$

where E = net hammer energy.

The loads at failure for all piles driven with a certain hammer were then plotted against the logarithm of the set, s The resulting curve was a straight line—nearly. Hence:

$$R \sim \log s \quad \ldots\ldots \quad (2)$$

Combining Eqs. 1 and 2 and introducing a constant of equality, a, yields,

$$R = a\sqrt{E}\log s \quad \ldots\ldots \quad (3)$$

However, since the range of pile driving involves negative as well as positive values of $\log s$, a second constant, b, must be introduced so that positive values of R will be obtained when s is equal to or less than unity.

$$R/\sqrt{E} = a \log s + b \quad \ldots \quad (4)$$

By the application of statistical methods and curve-fitting practice, it was shown that a and b are both nearly equal to about 0.50. Substituting in Eq. 4 and introducing a theoretical safety factor of 3 yields:

$$B = \frac{1}{7}\sqrt{E}\,(1 - \log s) \quad \ldots\ldots \quad (5)$$

where B = safe load-carrying capacity of pile, in tons

E = gross energy of pile-driving hammer, in ft-lb, times 75 percent for drop hammers, and 85 percent for all other hammers unless otherwise stated by manufacturer

s = set per blow, in inches

A probability analysis indicates that the proposed formula solved graphically in Fig. 1, will yield more consistently accurate determinations of bearing power than even the most complex "complete" rational type.

Also demonstrated was the fact that

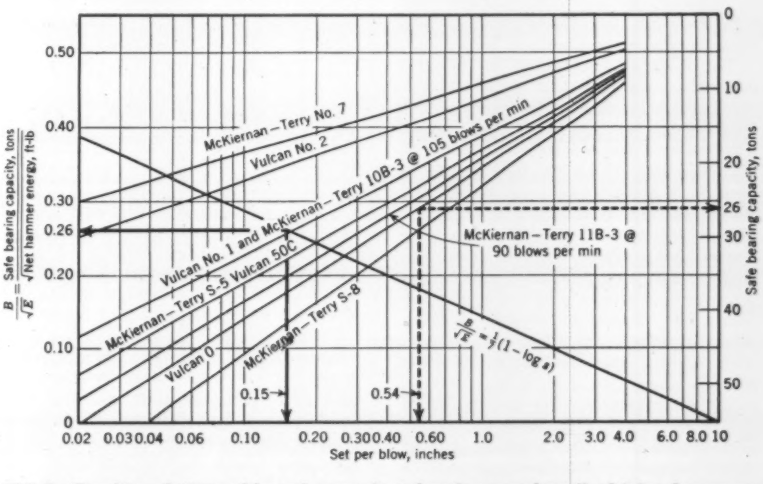


FIG. 1. Graphic solutions of formula are given for nine popular pile-driving hammers. General solution is also charted, showing straight-line relation between s, permanent set per blow, and B $\sqrt{E}$, giving factor of safety of 3, based on 130 pile load tests. Ordinates in this graph are not related but abcissa is common to both.

as long as the pile is capable of transmitting the applied load to the supporting soil, it is of no significance of what material the pile is constructed. This statement is true of the ability of the pile to "carry" a given load. However, other aspects must be considered before specifying a pile type, that is, ability to withstand driving conditions without damage, resistance to the elements, and of course economy.

Examples solved by graph

Two examples are given and solved in the graph, Fig. 1.

In the first example, it is desired to obtain a pile that will safely carry 26 tons. To what set should the pile be driven if a Vulcan No. 0 hammer is to be used?

By the heavy dashed line, the answer is shown to be 0.54 in.

In the second example, a pile is driven to a set of 0.15 in. with a drop hammer having a ram weighing 3,000 lb and a drop of 12 ft. What is the safe bearing capacity of the pile?

To find the answer, note the value of $B/\sqrt{E}$ in Fig. 1, as shown by the heavy solid line. It is 0.26. Then

$$E = 3{,}000 \times 12 \times 75\% = 27{,}000 \text{ ft-lb}$$
$$\sqrt{E} = 164$$

Hence $B = 164\ (0.26) = 42.6$ tons.

Difficulty of accumulating data

Needless to say, the accumulation of accurate data relating to piles loaded to failure is a cumbersome task. Extensive efforts on my part for the past two years have uncovered less than 150 published results. This article was therefore based on an analysis limited to correlating the load at failure to the net energy of the pile-driving hammer and the set per blow. Although the resulting formula appears to be the most accurate offered to date, it is believed that, with additional data, a formula that will predict the bearing capacity to within a maximum deviation of 20 percent, regardless of driving conditions, would be possible.

This of course would involve additional correlations, such as the P/W ratio, ram velocity, etc. No less than 300 additional load-test results would be necessary to make these correlations or otherwise to improvise on the proposed formula. The writer would appreciate help in procuring these data.

THE READERS WRITE

Scarcity of engineers tied to poor economic reward

To the Editor: The present ferment about the need for more and more engineers and scientists seems to have ignored one of the most important factors—that of the ultimate economic reward. It is a well known fact that engineers in all fields receive less economic return for equivalent experience and contributions to society than do other professions.

The college student cannot be lured into engineering and scientific work by high starting salaries alone. If he makes a careful investigation, he finds that his salary will be 50 to 70 percent of the salary of engineers with 15 to 25 years of experience. It is not only an ironical joke but actual fact that graduates with advanced degrees will receive more than the professors under whom they studied. The engineer with long years of experience has received increases in remuneration which barely keep abreast of the cost of living index. In other words, there is no net gain from added experience. This condition prevails in private engineering practice, in the government services, and in education. General salary increases are almost always based on a scale which has the largest percentage at the bottom and little or nothing at the top. The country is paying dearly for this shortsighted leveling policy.

Some day economic pressure from those at the bottom of the experience and salary scale will produce upgrading at the top. Even if we disregard the injustices to those engineers who have made their contribution to society, we can never make up for the loss of potential talent of those who might have entered the technical professions. The few who are willing to sacrifice their lives for the good of mankind will enter the ministry, not engineering.

Gordon R. Williams, M. ASCE
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Mass. Inst. of Tech.

Cambridge, Mass.

Five-year curriculum needed—to foster creative thinking

To the Editor: It seems to me that Professor Folk (February issue, p. 47) is arguing for a fifth year for the purpose of teaching subjects which should have been covered in high school. Dean Weil of the University of Florida made the same point in an article in the *American Engineer* for February 1956.

The fifth year is needed, *but* it is needed for additional subjects at present lacking in the engineer's education, unless we are to continue to turn out technicians instead of engineers. There is need to "make the engineer a citizen, too," as someone wrote last year. Statistics, geography, history, politics, sciences not directly related to engineering, literature, fine arts, ethics, logic—with the crying need to add all these to the present curriculum, we certainly cannot waste this additional year in teaching subjects required for entrance. An intensive review of mathematics is needed, to be sure, to insure that all are on the same level. But I stress that it should be a *review*.

The engineer is one who can relate an engineering structure to the needs of humanity—who can prove the need and value of the structure, whether or not he builds it. He needs to know basic principles, not handbook methods. Technicians can build.

The engineer deals with three basic commodities—men, money, and materials. Today's stress on the materials aspect leaves little time for the student to absorb knowledge about the other two except by osmosis.

He needs to know something of how to handle men, not only in order to get work out of them (or to work with them) but in order to "sell" his own product—ideas. Ideas are worthless unless they can be presented and accepted. Courses, then, in elementary psychology, in logical thought, and in clear, concise report writing are indicated. It might also be argued that a course in public speaking is necessary, but I believe that learning to talk on one's feet can be taught by requiring each student to recite daily, while standing on those feet.

He needs to know something of funding, particularly basic cost accounting.

Above all, he needs to have ingenuity and imagination fostered, and curiosity deliberately developed. I suggest here that geography—the sources of the materials with which he will work—and something of the processes by which they are developed would be in order, or better, a course such as Prof. John Arnold's "Creative Thinking" at M.I.T.

By all means let us have that fifth year. But let's not waste it on making up preparatory work. It is too badly needed for more advanced subjects.

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Fort Monroe, Va.

Relationship between beam depth and span

TO THE EDITOR: I have just read John Webster Brown's article, "Beam Moment of Inertia Determined by Table," in the December issue, p. 68. The purpose of his table is to give a quick method of determining the moment of inertia required in a simple beam in order to limit deflections. It is because a simple and well known relationship exists between the depth of a beam and its span that no elaborate tables can be found.

As an example, assume that it is desired to limit the deflection of a steel beam to 1/360th of the span. If

Δ = deflection, ft
w = load, lb per ft
l = span, ft
f = fiber stress, psi
E = modulus of elasticity, psi
I = moment of inertia, in.^{4}
M = moment, ft-lb
d = beam depth, in.
c = ½ beam depth, in.

the deflection expression for a uniformly loaded simple beam is

$$\Delta = \frac{5}{384}\frac{wl^4}{EI}144 = \frac{l}{360} \quad . . . (1)$$

Also,

$$f = \frac{Mc}{I} = \frac{wl^2d}{16I}12 = 20{,}000$$

$$\text{or } d = \frac{320{,}000}{12l^2}\frac{I}{w} \quad . . . . (2)$$

$$\text{From Eq. 1, } \frac{I}{w} = \frac{1800 \times 144l^3}{384 \times 30 \times 10^6} \quad . . . (3)$$

Substituting Eq. 3 in Eq. 2 we get

$$d = 0.60\,l \quad . . . . . . (4)$$

The significance of Eq. 4 is that if a uniformly simple beam is stressed to no more than 20,000 psi, and if the depth of the beam (in inches) is equal to, or more than, 6/10ths of the span of the beam (in feet), the deflection will not be more than $l/360$. Similarly, the ratio of depth (in inches) to span (in feet), to limit the deflection to $l/240$, is 0.40.

It is the above derivation that forms the basis for Section 17*a* of the well known AISC specifications for structural steel.

RALPH M. BAUMGARTEN, J.M. ASCE
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The J. G. White Eng. Corp.

New York, N. Y.

Table found useful tool for beam design

TO THE EDITOR: The method presented by John Webster Brown, J.M. ASCE, in the December issue (p. 68) for determining the moment of inertia necessary to limit the deflection of a beam under uniform load to some desired fraction of the span is a useful tool for the designer. It is evident, as Mr. Brown points out, that the use of the table giving the values of I/w which a beam must furnish to limit the deflection to $L/240$ or $L/360$, will result in a saving of time, as it has done in his office. The method would seem to be of greatest value in situations where beams of limited depth must be used so that the beam stresses are less than 20,000 psi.

A very simple and useful relationship between the depth of a beam d and its span length L can be developed on the basis that the beam will be stressed to its allowable fiber stress f and that the maximum deflection will not exceed L/N. From $f = Md/2\,I$ and $M = WL/8$, we find that $I = dWL/16\,f$. The deflection of the beam is $5WL^3/384\,EI$, and if this is to be limited to L/N, then $L^2 = 384\,EI/5\,WN$.

Substituting the previously found value of I in this equation for L^2 and simplifying, $d = 80\,fNL/384\,E$. For a beam carrying a load P at the center of the span, a similar analysis shows that $d = fNL/6\,E$.

For a steel beam with $f = 20$ kips per sq in (ksi), and $E = 30{,}000$ ksi,

FOR Δ OF:	UNIFORM LOAD	LOAD AT CENTER
$L/360$	$d'' = 0.60\,L'$	$d'' = 0.48\,L'$
$L/240$	$d'' = 0.40\,L'$	$d'' = 0.32\,L'$

For a wood beam with $f = 1.5$ ksi and $E = 1{,}760$ ksi,

FOR Δ OF:	UNIFORM LOAD	LOAD AT CENTER
$L/360$	$d'' = 0.77\,L'$	$d'' = 0.61\,L'$
$L/240$	$d'' = 0.51\,L'$	$d'' = 0.41\,L'$

The use of this rule can be seen in the selection of a steel beam to carry a load of 1,000 *plf* on a 20-ft span. The required section modulus is found to be 30, and the depth should be not less than 0.60 x 20 = 12 in. All the following beams are strong enough to hold the load, but the 10-in. beams may not be stiff enough to limit deflections to $L/360$, as follows:

SECTION	S	I	I/w
12 WF 27	34.1	204.1	0.204
10 WF 29	30.8	157.3	0.157
10 WF 39	42.2	209.7	0.210

If space limitations make it necessary to use a 10-in. beam, it then becomes necessary to design for stiffness. Mr. Brown's very useful table shows that $I/w = 0.180$ for a 20-ft span, so that we must choose a beam with a moment of inertia of at least 1,000 x 0.180, and this is furnished by the 10 WF 39. The stress in the beam would be 30/42.2 x 20, or 14.2 ksi.

In many cases the beam selected for strength will have a depth that meets the requirement that d be at least 0.6 L for $N = 360$, or 0.4 L for $N = 240$. If this is not so, on account of light loads or space limitations, Mr. Brown's I/w table will be very helpful.

ANTHONY HOADLEY, M. ASCE
Prof. of Civil Eng.
Union College

Schenectady, N.Y.

Sharp-eyed reader

TO THE EDITOR: With reference to the article on beam moment of inertia, by John Webster Brown, J.M. ASCE, in the December issue, p. 69, I want to call attention to the incorrect statement of the formula for I, upper left-hand corner of this page. Mr. Brown writes

$$I = \frac{5\,wl^4}{384\,Ed}\text{, whereas he should have}$$

$$\text{written, } I = \frac{5\,Wl^3}{384\,Ed} \text{ or } I = \frac{5\,wl^4}{384\,Ed\,12}.$$

But his answer next below is correct.

Don't let this happen again because some of us old engineers have eagle eyes.

I. G. GRUNDEL, Life Member, ASCE

Sacramento, Calif.

SOCIETY NEWS

Buffalo Convention Roundup

The program for the Society's next Convention—slated for Buffalo, N. Y., June 3-7, with the Buffalo Section as host—is stressing the many local projects and installations of sure-fire engineering interest. In addition to the featured inspection trip to the St. Lawrence Seaway and Power Project on June 7 (February issue, page 65), there will be daily tours to supplement the stimulating technical program.

The Technical Program Committee, headed by Louis S. Bernstein, announces that one or more sessions have already been arranged by the Construction, Highway, Hydraulics, Power, Structural, Waterways and Harbors, and Sanitary Engineering Divisions. Prominent engineers from both Canada and the United States are being lined up as speakers. The detailed program will appear in the April issue. In the meantime, the Technical Program Committee provides the following brief preview that will give a general idea of some of the sessions.

The **Waterways and Harbors Division,** in conjunction with the **Hydraulics Division,** will deal with many aspects of the St. Lawrence Seaway and Power Project, including the hydraulic design of the navigation and power facilities, model studies, and the details of construction planning and administration. This Division will also present papers concerned with Great Lakes harbors, traffic control, water level control, and harbor protection.

Part of the **Structural Division** program will also be devoted to design aspects of the St. Lawrence Project. Other papers scheduled will discuss folded plate construction and wind forces.

A complete program on the design, fabrication, and installation of penstocks is on the **Power Division's** agenda. Included in this series of papers are discussions on the specific treatment of anchor block design, water hammer analysis, high-pressure wyes, and penstocks. Also scheduled is a comprehensive study of the design and construction of the Niagara Mohawk Power Corporation's 100,000-kw multi-stage hydroelectric development and five-billion-cubic-foot storage reservoir on the Raquette River in northern New York.

In a different category are other interesting sessions being arranged by the Committee on Conditions of Practice. These sessions will be devoted to problems of Junior Members in addition to a general review of conditions of practice.

Varied Tours offered

A high point of the **Structural Division** program will be a field trip to the Buffalo plant of the Bethlehem Steel Corporation. The Buffalo installation is Bethlehem's third largest plant and the sixth largest in the world in terms of steel production. It is currently producing 5½ million ingot tons annually which is in excess of its rated capacity. The strip mill and bar mill are among the points of interest to be included on the ASCE tour. A $100 million expansion program is almost completed at the Lake Erie shore plant which employs nearly 20,000 workers.

The **Power Division** tours include visits to the Canadian Sir Adam Beck Hydroelectric Station and to the Hunt-

Entrance to Buffalo Harbor is shown here. Recently completed Buffalo Skyway, an over-city, over-harbor route, may be seen in the left background. Engineers will be interested in the many special design features incorporated in this scenic highway.

ley Steam Electric Generating Station, both located on the Niagara River. The Sir Adam Beck Hydro Station includes two installations—the first completed in 1930 with a capacity of 525,000 hp and the second completed in 1956 with a capacity of 1,428,000 hp. The second installation has twelve Francis-type turbines with a rated head of 292 ft. Two 45-ft-dia tunnels divert water from the Niagara River above Niagara Falls. From the 5½-mile tunnels the water enters a 2½-mile canal which discharges into the forebay. One interesting feature of the plant is a pumped storage development, designed to make possible substantial daytime peaking.

Another feature of this Niagara trip will be a visit to the remedial works and weir above the Falls. This project was designed to provide more even distribution of flow over the brink of the Falls and to maintain desired water levels in the upper reaches of the river.

The Huntley Steam Station, where the Niagara Mohawk Power Corporation is currently installing two 200,000-kw units, will soon have an installed capacity of 1,200,000 kw. A 350-ft-high stack for the new units is constructed of reinforced concrete. The close-coupled compound turbines will operate at 2400 psi and 1050 deg F. Speed of the high-pressure shaft is 3600 rpm while the low-pressure shaft runs at 1800 rpm. It is expected that 900 Btu will produce one kwhr. One innovation for this installation is the introduction of 230-kv underground cables between the transformers and outdoor switching station. The new units are placed in the same area formerly occupied by four 30,000-kw stoker-fed units.

The **Highway Division** will visit both construction sites and completed portions of the New York State Thruway. The entire 400-mile highway from New York to Buffalo is now open to traffic. Scheduled to be opened in 1957 is the 80-mile stretch between Buffalo and the western border of New York near Erie. The Thruway is a toll road, constructed and operated by the New York State Thruway Authority. It is free from all intersections and represents the latest in modern highway design.

Attention, Ladies!

Wives and other lady guests are the paramount consideration of the Women's Activities Committee, which is headed by Mrs. Ralph H. Gallinger. A sightseeing trip to Niagara Falls and adjacent points of interest, with luncheon at the Country Club, is just one of numerous interesting events being planned. The committee urges all who possibly can to accompany their husbands to Buffalo.

EJC Holds Its Third General Assembly

The engineer in government, particularly in defense, the engineer and international relations, and the ever-important question of what he should be paid in our expanding economy were the principal and well analyzed topics at the recent Third General Assembly of Engineers Joint Council.

In the first session of the assembly, which spotlighted the engineer in government, Panelist Philip Young, chairman of the U. S. Civil Service Commission and adviser to the President on Personnel Management, said that while current considerations include greater emphasis of professional standing, the trend is away from reestablishing the separate, or P, grades. He further felt that the present pay structure is too rigid and that greater flexibility would improve the government's position in competing for the limited supply of engineers and scientists.

A second panelist, Maj. Gen. J. B. Medaris, who heads the Army Ballistic Missile Agency, was emphatically critical. He sounded a sharp warning in stating that, "We have done very little to remedy the inadequate supply of engineers. . . . Further delay in coming to grips with this problem will imperil national security and impede the further progress of our country." The third speaker, Dr. Ernst Stuhlinger, also from the ABMA, voiced the opinion that our training of engineers tends to be too general and that insufficient emphasis is being placed on the basic sciences and mathematics. The picture on the state level is not very bright, according to Kentucky State Highway Engineer Dwight H. Bray. Low pay and slow advancement are major impediments to the recruitment of young men to state highway departments. Although there are the satisfactions of performing a good job for one's fellow citizens, these are not sufficient to overcome the allure of private practice. Moderator for the session was ASCE Secretary Emeritus William N. Carey.

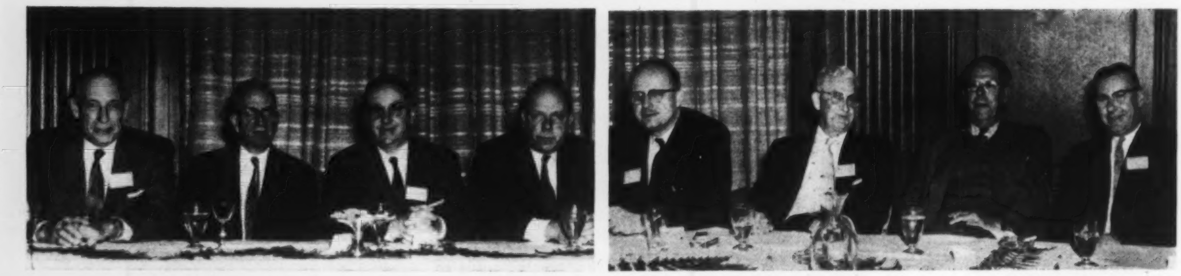
Salaries, the theme in the background of all Assembly discussions, became the central topic at the second session. In discussing "Trends in Professional Compensation," Dr. E. B. Peck proposed that account be taken of three independent factors, namely, ". . . the secular trend or general increase that is granted to all without regard to individual experience or merit . . . experience which must be taken account of throughout the whole career. . . . Finally, there should be reestablished a merit differential that has real incentive value." Donald P. Krotz, assistant to the president of the California Research Corporation, and Frank Leamer, personnel director of the Bell Telephone Laboratories, discussed aids to engineering salary administration—position evaluation and merit rating.

The third session was devoted to the impact of the engineer, working overseas, on international relations. Chairman of the session was Gail Hathaway, Past-President of ASCE. Speakers included Carl W. Flesher, director of the Office of Industrial Resources, International Cooperation Administration; James T. Duce, vice-president of the Arabian American Oil Company; and C. P. Dunn, president of the International Engineering Co., Inc. Mr. Dunn summarized his views in these words, "It

HOTEL STATLE

Gail A. Hathaway, Past-President of ASCE and Special Assistant, Office of the Chief of Engineers, presides at panel meeting on "The Impact of the Engineer in International Relations."

William N. Carey, Secretary Emeritus of ASCE, is chairman of panel on "The Problems of the Engineer in Government Service."



Glimpsed at head table at Unity Dinner during Third Annual Assembly of EJC are (left to right in left-hand photo) EJC President Joseph W. Barker, T. B. Counselman, P. Weir, and W. L. Everitt. Right-hand view shows (in usual order) L. Buehler, Jr., Maj. Gen. J. B. Newman, ASCE Past-President Carlton S. Proctor, and J. K. Latham.

is relatively easy to provide technical skill and service. The thing that is urgently needed and which is not easy to supply is management skill—using a broad definition of management. The need is for the ability to plan, organize, coordinate, and then carry out the plan —in short the ability to get things done. . . . It is not easy to supply (abroad) because we do not have enough of that commodity here at home." Throughout his talk, Mr. Dunn emphasized that, whether he wants to be or not, the American abroad is the representative of his country, and the main problem is one of relations between human beings.

The meeting also included a Thursday luncheon at which Dr. John Bell Rae spoke on "The Engineer and the American Economy"; a special Thursday dinner addressed by Dr. Henry T. Heald, president of the Ford Foundation; and a Friday luncheon at which W. A. B. Iliff, vice-president of the World Bank, interestingly developed the topic, "Overseas Development, Engineers, and the World Bank."

Increased Use of E.S. Library Reported

The number of persons using the Engineering Societies Library increased again last year, the increase amounting to 7 percent. In addition, more than 75,000 photoprints were supplied to users —an increase of 15 percent over the previous year. These are some of the facts brought out in the Forty-third Annual Report of the Library.

Unlike most libraries, the Engineering Societies Library can be used at long-distance range. Thus over half of the 43,000 persons who made use of its facilities last year did not come to the Library. Most orders for photoprint and microfilm copies of articles, for bibliographies, book loans, literature searches, and translations are received by mail.

During the year it was found necessary to increase some rates, in which no changes had been made since 1948. Searches are now $6.00 an hour, a $1.00 increase. Translations of Russian, Dutch, Portuguese, and Swedish into English are now $2.25 per hundred words—a 25-cent increase. German, French, Italian, and Spanish are still translated at the rate of $1.50 per hundred words. Photoprints have been raised 5 cents each to 45 cents a print (all photoprints are now sent by first-class mail). Microfilming is $1.50 for each 40 pages—copying one article in one volume. Formerly there was no limit on the number of pages. Only members may borrow books, which are still loaned at the rate of 50 cents a week.

Income from paid services supplied by the Library has doubled in the past six years. While much of this may be due to increasing business and research activity, some of it is attributed to better promotion in recent years. The ESL Folder, describing the Library and giving information about its services and rates, was revised and reprinted.

Ralph H. Phelps is director of the Library, which is located at 29 West 39th Street, New York 18, N. Y.

EJC Reports on Professional Income

The Engineers Joint Council report, "Professional Income of Engineers—1956," is now available at $1.50 a copy from EJC headquarters, 29 West 39th Street, New York 18, N. Y. The report is based on 1956 incomes of about 110,000 engineering graduates employed in industry, government, and education. As in the 1953 report, data are presented in various graphic and tabular forms to facilitate analysis, statistical comparison, and the development of trends.

Intersociety Meeting on Irrigation and Drainage

"Can Man Develop a Permanent Irrigation Agriculture?" is the theme of the first Intersociety Conference on Irrigation and Drainage to be held at the Sheraton-Palace Hotel in San Francisco, April 29 and 30. Sponsoring groups are the ASCE Irrigation and Drainage Division; the Soil and Water Division of the American Society of Agricultural Engineers; and the Conservation, Irrigation, Drainage, and Tillage Division of the Soil Science Society of America. These groups are cooperating with the U.S. National Committee of the International Commission on Irrigation and Drainage.

The various sessions will explore the role of water, crops, soils, and man in a permanent irrigation agriculture, and will present a battery of experts in the field of water conservation and use.

Harvey O. Banks, M. ASCE, director of the California Department of Water Resources, will call for teamwork in the solution of water problems in a keynote session initiating the two-day program. Harry F. Blaney, chairman of the executive committee of the ASCE Irrigation and Drainage Division and principal irrigation engineer for the U.S. Department of Agriculture, will be chairman of the opening session.

Introduction to Report on Status of Surveying and Mapping

BROTHER B. AUSTIN BARRY, Chairman, Task Committee on Status of Surveying and Mapping

The Task Committee on Status of Surveying and Mapping, appointed by the Surveying and Mapping Division, has been at its study for two years. It aims to achieve a sound basis for proper evaluation of professional relationships.

While surveying in all its aspects has traditionally been identified with civil engineering, in recent years there has been less conscious identification with it despite the expansion of civil engineering into new fields as man discovers, deduces, and devises new areas of exploitation. Land surveying is more evidently separated in the public view, as also in the engineers' view. No longer is it as axiomatic that a land surveyor is a civil engineer, although paradoxically there are probably more civil engineers engaged in land surveying than ever before in history.

Mapping today has achieved a new eminence through the emergence of photogrammetry as a procedure. It is possible now to execute topographic maps at fabulous speed—in months instead of years—with hitherto impracticable accuracy and with great saving. Today it is increasingly uneconomical to omit the use of photogrammetric methods in civil engineering projects.

Both these and still other phases of surveying and mapping have been of concern to the Society because questions of protocol and procedure have been raised in their regard. The determination of ethical procedure in executing surveying work is of necessity based upon proper understanding of the professional status of the activity and of the individuals engaged therein. Competitive-price bidding is just one of the important problems to be resolved in engaging surveying personnel for construction or mapping, as also in the execution of contracts for topographic mapping.

The decision that one or more phases of surveying and mapping are not civil engineering would, of course, remove such work from the purview of the Society. On the other hand, such aspects of surveying and/or mapping as are deemed to be both professional work and civil engineering work must be made to conform to accepted codes of ethics and of professional practice.

The major findings of the study are published here in an attempt to secure wide response on as broad a base as possible. Particular attention is drawn to the tentative finding that Category I (Land Surveying) is not civil engineering.

To make a study of this sort truly representative of prevailing conditions nationally, it is desirable to afford opportunity to the many in all divisions of civil engineering to express their views. Comments are therefore invited from all the membership. The implications are far reaching, for surveying and mapping form the broad base for every branch of civil engineering. [Comments should be sent to Brother B. Austin Barry, A.M. ASCE, Manhattan College, New York, N. Y.]

Interim Report of Task Committee on Status of Surveying and Mapping

(Received by the Executive Committee of the Surveying and Mapping Division, Oct. 18, 1956)

Brother B. Austin Barry, *Chairman* **Alfred O. Quinn** **George D. Whitmore**

A year ago, on October 24, 1955, the initial report of this Task Committee was presented to the Executive Committee of this Division and was accepted and adopted by them as an official statement of the Division. The report was subsequently published as Proceedings Paper No. 921 in the Journal of the Surveying and Mapping Division, Vol. 82, No. SU1, in March 1956 under the title, "Professional Aspects of Surveying and Mapping." Discussion of the paper was concluded on August 1, 1956, and the discussion has since appeared in the Journal, Vol. 82, No. SU2, in September 1956. A closing discussion by the Task Committee (the authors) will be prepared in the near future for presentation in the pages of the Journal.

The first report ("Phase One" Report) defined "professional," "technician-level," and "pre-professional" tasks in each of six categories of surveying and mapping activities. No attempt was made, however, to ascertain which tasks or which categories were engineering in nature, this being a task beyond the assigned scope of the first phase of the study.

Following the receipt of the October 1955 Report, the Executive Committee directed the Task Committee to proceed without delay to study the next question in order—namely, the determination of which categories of surveying and mapping should properly be construed as engineering and which should be considered non-engineering. This has been the subject of study during the intervening months, and it is now felt that a preliminary statement can be made for presentation at this time. Certain details still remain to be clarified, but the major lines of demarcation are clear. The following paragraphs cover the general disposition of each category without necessarily presenting the entire case for the decision; the fuller presentation at a later date will cite all the reasons therefor, including documents merely mentioned here.

The Task Committee believes that its findings are in conformity with the definitions of Practice of Engineering in the widely accepted Model Law (July 1946) for the Registration of Professional Engineers and Land Surveyors. . . .

Category I—Land Surveying (Cadastral)

The committee believes that it has no choice but to recommend that land surveying be regarded as an activity separate and distinct from engineering, in view of certain official pronouncements, as follows:

(*a*) 1948, National Council of State Boards of Engineer Examiners (NCSBEE) approval of report of its Committee on Land Surveying, which recommended separation of land surveying from engineering.

(*b*) 1952, National Society of Professional Engineers (NSPE) Resolution No. 1-52, endorsing the 1948 NCSBEE report cited above.

(*c*) 1956, NCSBEE approval of report of its Committee on Land Surveying, which in effect affirms its 1948 position, and spells out in more detail why land surveying should be separate from engineering, as well as what should be included under engineering surveys.

Within the province of the land surveyor is certain land subdivision work in which he shares responsibility with the engineer. For example, the subdivision of land tracts is to be planned by the engineer (such as the fixing of street alinement and grades, sewerage design and grades, drainage design, etc.), while the layout of lots, calculation of plot areas, subdivision of parcels according to a predetermined general plan, and filing of the subdivision plan is the task of the land surveyor.

Category II—Engineering Surveys for Design and Construction

All of the work in this category is widely recognized as engineering. The informational surveying (investigations, and the obtaining of qualitative and quantitative data) for the design and development of engineering projects, as well as producing maps (by photogrammetric and/or ground methods) has always been considered engineering work. Similarly, all surveying layout incident to the construction of such projects is itself engineering.

On the occasions and to the extent that informational or construction surveys require the establishment of property lines or corners, it is to be noted that such location and establishment is to be regarded as land surveying.

Category III—Geodetic Surveying, Geodetic Engineering or Geodesy

Most of the operations within this category (which the Committee will recommend be called Geodetic Engineering) are regarded as engineering, the exception being certain work (e.g., figure-of-the-earth computations) which is strictly geodesy and which may be regarded as non-engineering in nature, albeit scientific and professional.

Category IV—Cartographic Surveying, Cartographic Engineering, or Map and Chart Surveying

The Task Committee believes that the professional work within this category, which the committee recommends be called Cartographic Engineering, must be regarded as engineering, in view of certain official pronouncements, as follows:

(*a*) Resolution dated March 3, 1952, by ASCE Board of Direction, stating that "the planning, execution, and direction of the professional surveying activities that are necessary for the production of the Government's standard series of maps and charts, as well as similar work elsewhere, are professional engineering."

(*b*) The previously mentioned 1948 report approved by NCSBEE, which states that "the surveying necessary for the preparation of a topographic map is engineering surveying and not land surveying."

(*c*) The previously mentioned 1952 Resolution (No. 1-52) of NSPE approving the 1948 NCSBEE statement cited immediately above.

(*d*) The previously mentioned 1956 approved report of the Committee on Land Surveying of NCSBEE which, like the 1948 report, clearly defines topographic surveying and hydrographic surveying as engineering surveying, and specifically excludes them from land surveying.

Furthermore, the Task Committee is under the impression that most of the state boards for registration of engineers consider, and in some cases have specifically ruled, that such work as topographic surveying and mapping is engineering, and therefore must be performed by those in private practice in compliance with the state laws for registration of engineers.

Category V—Aerial Survey Services

Attention is called to the use of photogrammetric means of accomplishing much of the work of Categories I, II, and IV. Category V therefore does not include the entire field of aerial or photogrammetric methods, nor even most of them, but merely certain adjunct services which can be separately considered.

The Task Committee finds that the operations listed within this category are not intrinsically engineering in nature, although any of them could become an important part of an engineering project, (The photogrammetric methods of the preceding four categories are engineering procedures by reason of their being operations of an engineering project, *e.g.*, the preparation of a topographic map.)

Category VI—Cartography (not requiring original surveys)

The operations of this category are deemed to be non-engineering, since they do not conform to the accepted definition of engineering work.

Conclusion

The Task Committee expects to finish its "Phase Two" Report by the spring or summer of 1957. Upon submission to the Executive Committee of the Division of such report, it is expected that except for minor revisions and possible discussion through "Proceedings" that the task of the Committee will be completed.

During this final period of rounding out all aspects of the study, the members are attempting to secure helpful opinions and to foresee areas of confusion so as to guarantee acceptance of the findings with a minimum of friction and delay. There seems to be a fairly uniform nationwide acceptance of the roles of the engineering surveyor and of the land surveyor. In the matter of photogrammetric activity, however, some apparent difference of opinion exists; some resolving of this difference can certainly be worked out, and it is the intention of the Task Committee to work up a fairly detailed and clear statement of its stand on this (and any similar) matter before presenting its final report.

We request comments on this Interim Report that may assist in clarifying the statements or opinions expressed. We are grateful to all those, within and without the Surveying and Mapping Division, for help received in this task.

The tenets used for the differentiation throughout the study are as follows:

Professional Level. Work performed by such a person involves the exercise of professional judgment, frequently based on knowledge acquired through higher learning, generally non-routine in character. The term implies one who can plan, perform, and/or direct all such operations in the category; this person is responsible for work performed by those under him.

Technician Level. Work performed by such a person is primarily routine, of a technical nature, often demanding a higher degree of skill, done under the direction of a professional person who is responsible for its outcome.

Preprofessional Level. Work at the technician level performed by a professional trainee who, having completed courses of specialized intellectual instruction and study, is seeking to attain professional status.

Definitions of Professional Positions

As a guide to the terms used for designating the several professional positions in the preceding outline, it is thought advisable here to include certain definitions. These follow generally the accepted definitions as given in ASCE Manual No. 34, "Definitions of Surveying, Mapping, and Related Terms" 1954, but are altered somewhat to more clearly describe the particular job function envisioned in this outline.

Land Surveyor determines location of land boundaries; prepares map showing shapes and areas of land; divides land into smaller tracts, including layout of roads and streets and rights-of-way to same to give access to smaller tracts; prepares official plats or maps of such land subdivisions; prepares and interprets land descriptions for incorporation in deeds, leases, etc.

Survey Engineer obtains information for planning or developing an engineering project and estimating its cost, often recording such information in form of an engineering map or plat.

Geodetic Surveyor (or Engineer) plans, performs, or supervises high-accuracy surveys as well as the computations and adjustments thereof, including such as triangulation, traverse, precise leveling, and astronomic observations, such surveys being of a magnitude that the required accuracy and precision can be obtained only through processes that involve figure and size of the earth.

Control Surveyor plans, performs, or supervises surveys and computations of horizontal and vertical measurements involving complex network adjustments, etc.

Topographer plans, performs, or supervises the construction of topographic maps of any scale, contour interval, or accuracy specification, including all surveying procedures and calculations required for such map construction; determines when and whether ground or photogrammetric surveys, or various combinations thereof, shall be used.

Photogrammetrist plans, performs, or supervises use of photogrammetric instruments and techniques in conjunction with various aspects of surveying, mapping, resource surveys, and the design of photo-interpretation systems.

Cartographer plans construction and compilation of charts and maps of small scale; assembles, evaluates, selects, and directs plotting of data therefor.

Map Editor performs many functions of the cartographer; especially designs form and content of maps; determines criteria for symbolization and nomenclature; reviews manuscript maps as to accuracy, completeness, correctness, and conformity with established standards.

The titles mathematician, electronic engineer, geographer, geophysicist, etc., are not defined herein specifically, since they are primarily persons in allied professions whose work only incidentally is in the field of surveying and mapping.

Classification of Positions in Surveying and Mapping

	Professional Level ***	Technician or Pre-Professional Level ****
I. **Land Surveying** (Cadastral)		
A. Property and Boundary Surveys*	Land Surveyor	Instrumentman
B. Subdivision Surveys and Plats *		Computer
C. Public Lands Surveys *		Draftsman
D. Surveys for Plans and Plats *		Tapeman
1. Architectural (Building-Site) Surveys		Rodman
2. Tax Maps		
II. **Engineering Surveys for Design and Construction**		
A. Design Data Surveys (including Route Surveys)*	Survey Engineer	Instrumentman Computer
1. Control, Horizontal and Vertical		Draftsman Tapeman
2. Culture and Topography		Rodman
3. Profiles and Cross-Sections		
B. Construction Surveys *		
1. Layout Surveys		
2. Quantity and Measurement Surveys		
3. "As-Built" Surveys a. Utility Surveys		
C. Mine Surveys		
III. **Geodetic Surveying, Geodetic Engineering, or Geodesy** (not to be confused with precise plane surveying)		
A. Control Surveys, First- and Second-Order Accuracy **	Geodetic Surveyor or	Instrumentman Observer
1. Horizontal: triangulation, traverse, and electronic trilateration	Geodetic Engineer Mathematician	Computer Gravimetric Operator
2. Vertical: spirit and trigonometric leveling		Recorder Signalman
B. Geodetic Astronomy		Tapeman
C. Gravity Surveys, Magnetic Declination Surveys, Figure-of-the-Earth Studies		Rodman
IV. **Cartographic Surveying, Cartographic Engineering,** or **Map and Chart Surveying** (surveys for constructing original maps and similar products)		
A. Control Surveys, Third- and Fourth-Order Accuracy **	Control Surveyor	Plane-Table Operator
1. Horizontal		Instrumentman
2. Vertical		Observer
B. Topographic-Planimetric Surveys and Maps *	Topographer	Computer Recorder
1. Photogrammetric Aero-Triangulation	Photogrammetrist	Draftsman Tapeman
2. Mapping Surveys		Rodman
a. Ground-Survey Methods		
b. Photogrammetric Methods		Stereo-Plotter
3. Field-Edit Surveys of Photogrammetric Compilations		Operator
C. Hydrographic Surveys **	Hydrographer	Observer
1. Soundings: fathometer, handlead, sounding pole		Recorder Computer
2. Sounding Fixes: three-point, electronic		Draftsman Leadsman
3. Wire-Drag Surveys		
4. Tidal and Current Surveys		
V. **Aerial Survey Services**		
A. Aerial Photography	Photogrammetrist	Photographer
1. Photo-Interpretation	Electronic Engineer	Photo-lab Technician
B. Electrical Measurements for distances and position fixes (shoran, etc.)	Mathematician Geophysicist	Photo-interpreter Computer
C. Airborne Magnetometer Surveys		Electronic Technician
D. Radar-Altimeter Profiles and Elevations		Magnetometer Operator Radar-altimeter Operator
VI. **Cartography** (not requiring original surveys)		
A. Map Design	Cartographer	Map Compiler
B. Compilations derived from existing source data	Geographer	
1. Evaluation of Maps and Other Source Data		
2. Nautical and Aeronautical Charts, Topographic and Planimetric Maps, Special-Purpose Maps, etc.		
3. Photomaps and Mosaics		Mosaicker
4. Relief Maps and Models		Modeler
5. Radar-Prediction Charts		
C. Map Editing	Map Editor	
D. Map Reproduction		
1. Engraving or equivalent		Engraver
2. Lithography		Lithographer

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* Photogrammetric procedures used when applicable on these and other activities.

** Electronic measuring procedures used when applicable on these and other activities.

*** See definitions following this outline.

**** Including some which are normally skilled craftsmen but which sometimes, by reason of special training, are properly considered technicians, e.g., rodman, tapeman, leadsman, signalman, etc.

ASCE Has Booth at the ARBA Road Show

Various members of ASCE helped to man the Society's booth at the recent Chicago Road Show. Shown here with Robert K. Lockwood (left), of the headquarters staff, are John E. Wiley, executive secretary of the American Association of State Highway Officials, and E. C. Crites, who is with the Portland Cement Association. The booth will be used later for display and sale of ASCE publications at Society Conventions.

Are You Eligible for Transfer?

You can help yourself professionally and aid the Society in recognizing the professional attainments of its members by transferring to the highest grade of membership for which you can qualify. By letter, by the efforts of Local Section officers over the past four months, and by items in Civil Engineering, Junior Members and Associate Members have been reminded of their right and opportunity to transfer to the highest grade of membership for which they are eligible. Many are doing so.

During December and January just past 200 Junior Members applied for transfer to Associate Member—three times as many as during the same months one year earlier. Some of these Junior Members are eligible in one step for Member grade. Applications received for transfer from Associate Member to Member during the same months were double the number received a year earlier. Have you submitted yours?

Forms for transfer are available either from offices of your Local Section, or from the Executive Secretary at Society Headquarters. Information for Junior Members wishing to transfer appeared in Civil Engineering for October 1956, page 79; for Associate Members wishing to transfer in the December issue, page 78.

Refresher Courses Open to Members

A series of evening courses designed to help engineers qualify for the professional engineering license in New York or New Jersey are being offered under the auspices of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The classes, meeting once a week for nineteen or twenty weeks, will review such areas as structural planning and design, basic engineering sciences, and engineering economics and practice, in addition to mechanical and electrical engineering.

Fees for each course are set at $15 for members of the sponsoring societies, and of the AIChE, ASCE, AIME, and New York State Society of Professional Engineers. For non-members the fee is $25. Further information and registration forms may be obtained by writing or telephoning F. H. Linley, c/o Allis-Chalmers Co., 50 Church St., New York, N. Y.

"Civil Engineering" Is Available in Microfilm

Availability of Civil Engineering in microfilm edition is announced by University Microfilms, 313 N. First Street, Ann Arbor, Mich., from whom it may be purchased. Volumes 1 through 19 (1949) are $100 a set, or $17.50 per volume. Subsequent volumes are priced as follows: Vol. 20 (1950), $3.60; Vol. 21 (1951), $3.75; Vol. 22 (1952), $4.65; Vol. 23 (1953), $4.40; Vol. 24 (1954), $4.50; and Vol. 25 (1955), $5.00.

The film is packaged in kraftboard cartons, suitably identified for the librarian or other user. Sale of the positive microfilm copies of current issues is limited to subscribers to the regular paper editions.

In addition to saving binding costs and valuable storage space, Microfilming also eliminates the need for replacing lost or damaged single copies.

Hydraulics Division Conference at M.I.T.

Planning is underway for another national-scale conference of the Hydraulics Division, to be held in Cambridge, Mass., August 26-28. The meeting will be held in the new Kresge Auditorium of the Massachusetts Institute of Technology under joint sponsorship of the Hydrodynamics Laboratory of M.I.T., the Northeastern Section of the Society, and the Hydraulics Section of the Boston Society of Civil Engineers.

There will be technical sessions on Design, Hydrology and Floods, Tidal Hydraulics, Research, and Sedimentation.

In recent years the summer meetings of the Hydraulics Division have been organized with increasing emphasis on attractions for the whole family. This meeting will continue that trend by offering interesting group activities in addition to access to some of America's most picturesque seashore and mountain vacation spots.

Index to Constitution

To facilitate reference to the ASCE Constitution, Bylaws, and Rules of Policy and Procedure, the Society has issued a new ten-page Index. Free copies are available upon request to the Executive Secretary, 33 West 39th Street, New York 18, N. Y.

Activities of Committee on Engineering Education

R. P. Davis, *Chairman*

This year's activities of the ASCE Committee on Engineering Education are mainly concerned with interesting more young men in becoming civil engineers, and in assisting in the formulation of engineering curricula best suited to the needs of civil engineers.

The shortage of engineers in general, and of civil engineers in particular, has been widely publicized during the past few years. The many informative articles on the subject should help to focus attention on what can be done to relieve the shortage.

The Committee on Engineering Education is sponsoring the Wednesday morning (February 20) program of the Department of Conditions of Practice at the Jackson Convention. The program consists of a panel discussion on "How to Attract Suitable High School Students to the Civil Engineering Profession." Another recent activity of the committee has been the sponsorship of a Society brochure primarily intended to interest high school students in civil engineering as a career and stressing the importance of mathematics.

The final ASCE "Report on Evaluation of Engineering Education" has been criticized by some civil engineering educators on the ground that the educational needs of the civil engineer may differ from those of the other branches, and that these needs are not being given sufficient attention.

In order that ASCE may better present the views of its members to ECPD through its Committee on Engineering Education, the committee has recommended that (1) one of the civil engineering representatives on ECPD should also be a member of the ASCE Committee on Engineering Education, and (2) one civil engineering member of the ECPD Committee on Education and Accredidation should also be a member of the ASCE Committee on Engineering Education.

ASCE MEMBERSHIP AS OF FEBRUARY 8, 1957

Members	9,339
Associate Members	12,377
Junior Members	17,525
Affiliates	73
Honorary Members	44
Total	39,358
(Feb. 9, last year	38,587)

ASCE CONVENTIONS

BUFFALO CONVENTION
Buffalo, N. Y.
Hotel Statler
June 3-7, 1957

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 14-18

CHICAGO CONVENTION
Chicago, Ill.
Sherman Hotel
February 24-28, 1958

TECHNICAL DIVISION MEETINGS

TECHNICAL PROCEDURE CONFERENCE
Oklahoma City, Okla.
Hotel Skirvin
April 12-13

INTERSOCIETY CONFERENCE ON IRRIGATION & DRAINAGE
San Francisco, Calif.
Sheraton-Palace Hotel
April 29-30
Sponsored by
ASCE Irrigation & Drainage Division
Am. Soc. of Agricultural Engineers
Soil Science Society of America

AIR TRANSPORT CONFERENCE
New York, N. Y.
Park Sheraton Hotel
May 15-17

STRUCTURAL PRESTRESSED CONCRETE CONFERENCE
San Francisco, Calif.
Fairmont Hotel
July 29-August 2

HYDRAULICS CONFERENCE
Cambridge, Mass.
Mass. Inst. of Tech.
August 26-28

WATERWAYS & HARBORS CONFERENCE
Princeton, N. J.
October 18
(Part of Annual Convention program)

DISTRICT COUNCIL CONFERENCES

NEW ENGLAND COUNCIL
Worcester, Mass.
Worcester Poly. Inst.
March 23
and

Local Section Conference
Worcester, Mass.
Hotel Bancroft
March 21 and 22

DISTRICT 9 COUNCIL
Columbus, Ohio
Deshler-Hilton Hotel
April 12-13

PACIFIC NORTHWEST CONFERENCE
Walla Walla, Wash.
April 26-27

PACIFIC SOUTHWEST CONFERENCE
San Jose, Calif.
May 2-4
and

Local Section Conference
April 30-May 1

LOCAL SECTION MEETINGS

Hawaii—Annual all-day spring conference in Waikiki, Oahu, May 15. With the theme of irrigation, the event is especially arranged for the convenience of engineers in San Francisco to attend the Intersociety Conference on Irrigation and Drainage and the Third World Congress on Irrigation and Drainage.

Illinois—Luncheon meetings at the Chicago Engineers Club every Friday noon.

Los Angeles—General dinner meeting, March 13, at 7:00 p.m.; dinner meeting of the Junior Forum, March 13, at 6:00 p.m.; dinner meeting of the Soil Mechanics Group, March 20, at 6:30 p.m.; dinner meeting of the Transportation Group, March 20, at 6:30 p.m.; dinner meeting of the Construction Group, March 21, at 6:30 p.m. (all in the Rodger Young Auditorium, 936 West Washington Blvd.); and dinner meeting of the Sanitary Group at the Engineers Club, March 27, at 6:30 p.m.

Metropolitan—Meeting at the Auditorium of the Engineering Societies Building, New York, March 20, at 7:00 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon.

Syracuse—Annual dinner-dance at Drumlins on April 27. Walter Neubauer will be chairman.

Tennessee Valley—Spring meeting in Asheville, N. C., May 17-18, with the Asheville Branch as host.

The new Asphalt constructed Route 128, near Boston, replaces the old route built 25 years ago. The highway consists of two roadways each of which has three 13' lanes and a 10' shoulder. Roadways are separated by a depressed grassed median varying from 30' to ¼ of a mile. The pavement consists of 12" well-compacted gravel sub-base, 4½" penetration macadam base, 1¼" Asphaltic concrete binder course and a 1¼" Asphaltic concrete surface course.

Old road that gave traffic "the creeps"

...built with high economy...for low maintenance...

Outmoded road conditions slowed traffic to a creep on the old Route 128, in Massachusetts.

So a new, wider Route 128 was recently completed ... for today's and *tomorrow's traffic.* With greater capacities ... better layout, grades and crossing eliminations.

It's a smooth-driving, long-lasting Asphaltic concrete highway. Built at low cost. To make cars and trucks glide along, safely. And to be easy on taxes ... for generations to come.

Modern heavy-duty Asphalt construction has proved to be ideal for highways and primary roads in every section of the country. It allows unusual design versatility ... speed and ease of construction.

Asphalt pavement is resilient, rugged, skid-resistant. Glare-absorbent. It seals out damaging moisture ... is not affected by de-icing salts that usually damage other pavement. Snow and ice melt faster, too. The way ahead is clear, quicker.

In the face of rising construction costs you can keep within budgets by paving with Asphalt.

You'll keep costs down ... keep performance high ... keep taxpayers happier ... when you design for modern Asphalt construction.

replaced with wide, durable Asphalt Highway

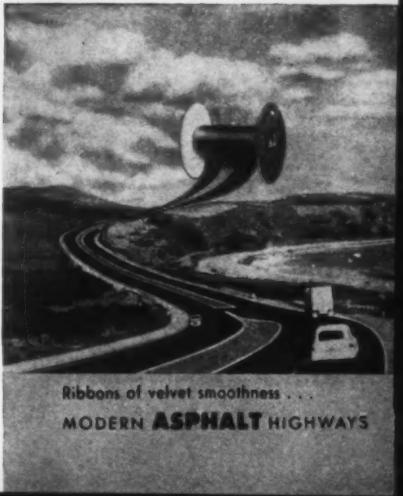
and low future taxes

PREFERS Asphalt Construction

One of the companies that played a leading role in the building of the new Route 128 is the M. De Matteo Construction Company, Quincy, Mass.

The Superintendent of this company, engineer Roland S. Delaware, writes, "I have worked with Asphaltic pavements since 1931, and have always advocated the use of Asphalt in preference to other types of pavement. I like it from an engineering standpoint...and enjoy the riding qualities and speed of construction."

THE
ASPHALT INSTITUTE
Asphalt Institute Building
College Park, Maryland



NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

New Central Ohio officers, installed at annual meeting on December 18, are Roy T. Underwood, first vice-president; Robert W. Duis, second vice-president; Prof. Emmet H. Karrer, past-president and installation officer; Prof. Charles B. Smith, president; Thomas W. Singell, retiring president; and O. H. Jeffers, secretary-treasurer.

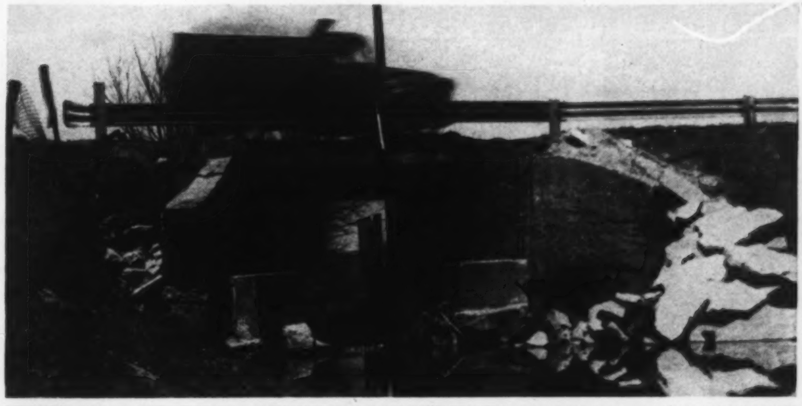
Life Membership Certificates were awarded to these prominent Cincinnati engineers at the Cincinnati Section's January meeting. The recipients (seated, in usual order) are Warren W. Parks, R. M. Miller, and George E. Oliver. Their sponsors (in rear row) were Herbet Schroth, Hunter W. Hanly, and Col. R. E. Smyser, Jr. Speakers were John E. O'Fallon, district engineer at Detroit, and Henry J. Stetina, regional engineer at Philadelphia, for the American Institute of Steel Construction.

Facts and figures proving that Northeastern Ohio offers industry lowest-cost access to markets in the whole continent were presented in the featured talk at the **Akron Section's** December meeting. The speaker—Nicolas P. Andreef, research director for the Area Development Committee—also noted that the marketing advantages of the area will be even greater when the St. Lawrence Seaway brings ocean shipping to the Great Lakes. There was a large turnout of wives, who were special guests for the occasion.

A fine program and large attendance marked the January meeting of the **Arizona Section's Phoenix Branch.** George R. Allan, Jr., of the local architectural firm of Allan & Olsson, spoke on the development of the residence dwelling in America, referring especially to modern structural trends, and outlined the progress of area planning in Phoenix.

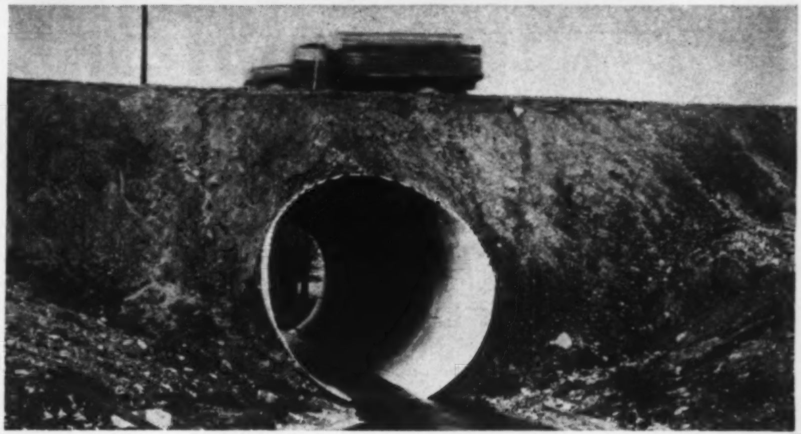
Charles J. Moritz, of Effingham, Ill., was honored with a Life Membership Certificate at the **Central Illinois Section's** January meeting in Urbana. In an informative illustrated talk, entitled "Greenland's Icy Mountains," Prof. W. M. Merrill, of the geology department at the University of Illinois, told of his experiences with a research team that was studying the North Glacier in Greenland in the summers of 1955 and 1956.

Sound rules for engineers (and others) to follow in buying stocks as an investment were given **Cleveland Section** members at their January meeting by featured speaker Burton Miller, vice-president in charge of trust investments at the National City Bank of Cleveland. Investing in the market is an art, not a science, he declared, and "many things should be considered before investing money in common stocks." With dividend yields on stocks decreasing and dividends on bonds increasing, bonds—especially those that are tax exempt—may be a better investment today than stocks, Mr. Miller pointed out. As a background for his provocative talk he



BEFORE

The bridge was narrower than the approach roadway. Notice large cracks in abutment.



AFTER

Multi-Plate Pipe made it possible to widen roadway with almost no reduction in waterway area. The ends of the pipe are beveled to fit the finished slope.

Armco MULTI-PLATE Pipe replaces narrow, failing bridge

New structure permits wider roadway, greater loads

An old concrete bridge on the Dayton-Yellow Springs Road in Greene County, Ohio, presented a dangerous traffic hazard. The bridge was scarcely wide enough for two cars. In addition, the old structure was weakened by crumbling abutments.

The county replaced the bridge with a 15-foot-diameter Armco Multi-Plate® Pipe under a 12-foot earth cover. This made it possible to widen the roadway so cars could pass safely. And the problem of load limit was eliminated.

Multi-Plate Pipe is one of many Armco products used for economical drainage and construction. Others include foundation piling, bin-type retaining walls, tunnel liner plates, sewer pipe, and steel buildings. There is a size and type of Armco product to help you solve practically any drainage or construction problem.

Write for data on the products that interest you. Armco Drainage & Metal Products, Inc., 4067 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

Pneumatic tampers were used to compact earth under the haunches of the pipe.

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David B. Smith, director of the Florida Water Resources Commission, explains some of the high points of his talk on the state's water resources to the new officers of the Gainesville Branch of the Florida Section. In usual order the new officers are Prof. Clifton C. Hill, vice-president; Dr. Smith; R. W. Pride, president; and Prof. Donald A. Sawyer, secretary-treasurer. Dr. Smith was featured speaker at Branch's first meeting of season.

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analyzed the present-day economy. New Section officers unanimously elected during the meeting, are John C. King, president; Michael J. Phillips, vice-president; and James M. Hicks, secretary-treasurer. Presentation of a Certificate of Life Membership to Alex Miller was another event of the evening.

Featured speaker at the **Colorado Section's** January meeting was Thomas M. Hollearin, assistant chief of the Estimates and Analysis Branch of the U. S. Bureau of Reclamation. Discussing "Trends in Heavy Construction Costs," Mr. Hollearin predicted a rise of about 10 percent in these costs in the year ahead. Another member of the Bureau of Reclamation staff—William R. Judd, engineering geologist in the Office of the Chief Engineer—addressed the Section's February meeting on "Civil Engineering in Mexico from the Aztec to Today." Illustrating his talk with colored slides, Mr. Judd showed interesting engineering contrasts in hydroelectric plants, dams, and large buildings.

Dewey S. Wright, city engineer for City and County of Denver, is newly elected president of the Colorado Section. Mr. Dewey is a past chairman of the executive committee of the Society's Air Transport Division and a member of the Colorado Engineering Council, the board of directors of the Colorado Society of Engineers, and other professional organizations. Completing the roster of 1957 Section officers are Emerson S. Ellett, vice-president, and Leo C. Novak, secretary-treasurer.

In the **Connecticut Section** the new slate—elected at the annual meeting in New Haven on January 18—is William S. Kaminski, president; William G. Weaver, Jr., vice-president; and Frank J. Zamecnik, secretary-treasurer. ASCE President Mason Lockwood was guest of honor and principal speaker, with a talk entitled "What ASCE Is Doing Now." Mr. Lockwood presented Life Membership Certificates to Claude W. Ullom and to Theodore Crane in absentia.

The **Duluth Section's Iron Range Branch** is planning an early meeting for local high school students interested in careers in civil engineering. At a recent dinner meeting the following officers were elected for 1957: N. T. Rykken, president; Donald Anderson, vice-president; and Thomas Gaffney, secretary-treasurer. Two films—showing modern expressway developments and the tilt-up method of constructing homes and commercial buildings—constituted the technical program.

Speakers at recent **Georgia Section** meetings have been two Georgia Tech faculty members. In an illustrated talk on "Earth Dam Construction," Prof. George F. Sowers showed the results of hydraulic, seepage, and structural failures. Since failure of dams endangers the public more than most structural failures, he recommended that consideration be given to legislation that would require an engineer's services for the design of earth dams exceeding a minimum height. Prof. Robert E. Stiemke, head of the civil engineering department, spoke on "Civil Engineering Education in Europe" at the February meeting. A recent four-month tour of the British Isles and the continent provided the background for his findings and observations. The **Savannah Branch** recently installed the following new officers: John M. Henderson, president; Clarence C. Brown, vice-president; and John S. Wiley, secretary-treasurer. Mr. Henderson was featured speaker, with a talk on water-resource development in India.

At the helm of the **Indiana Section** for the coming year are Prof. Frank W. Stubbs, president; Joseph I. Perry, vice-president; Prof. Gerald H. Teletzke, secretary-treasurer; and Richard O. Albright, assistant secretary-treasurer.

Time saved by photogrammetric methods of mapping was emphasized in a panel discussion of aerial photography presented at the January 9 meeting of the **Maryland Section.** Talk ranged from descriptions of the various types of plotting equipment currently in use to detailed reports of specific applications to both large and small projects. The experts were Henry P. Eichert, of the U. S. Coast and Geodetic Survey; Page F. Hopkins, of the consulting firm of Maddox and Hopkins, Silver Spring, Md.; Norman M. Pritchett, chief engineer of the Maryland State Roads Commission; and Thomas L. Collins, president of Maps, Inc.

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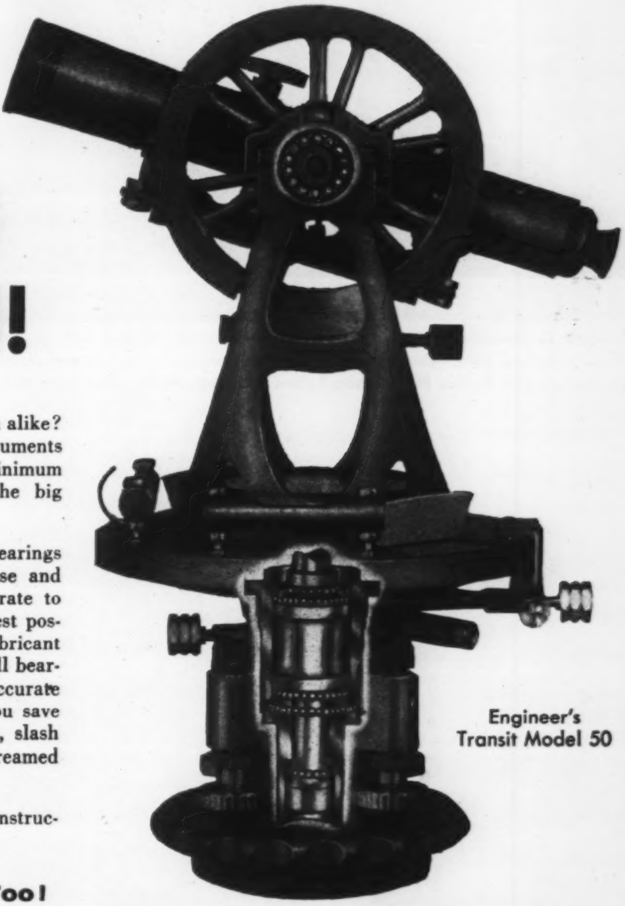

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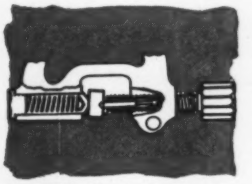

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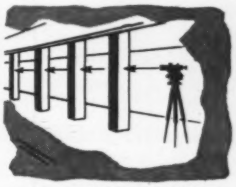

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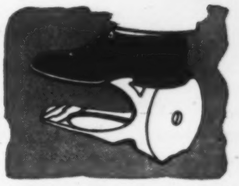

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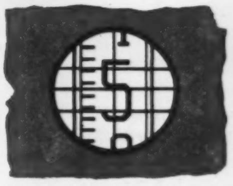

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New Hawaii Section officers are pictured here. Reading left to right, we have Wayne E. Duncan, secretary; Edward J. Morgan, second vice-president; Francis Wai, outgoing president; Donald S. Austin, incoming president; Robert T. Chuck, treasurer; and Arthur N. L. Chiu, Junior Member of the executive committee.

These five new Life Members display their certificates received at the January meeting of the Kansas City Section. They are, in usual order, S. J. Cunningham, Col. William H. Spann, C. S. Foreman, H. M. Brush, and C. B. Kimberly. Over 200 attended the meeting, which featured a panel discussion on engineering education and curricula in the United States. Taking part were faculty from four of the largest technical schools in the Missouri-Kansas area.

The **Metropolitan Section's Junior Member Forum** arranged and conducted a joint meeting enjoyed by both groups on January 16. Featured speaker was John J. Theobald, civil engineer, educator, and deputy mayor of New York. Before entering the city's administration Dr. Theobald was dean of administration at the College of the City of New York and president of Queens College. He spoke on the provocative topic of "The Engineer in Public Life."

New officers of the **Little Rock Branch** of the **Mid-South Section** are L. R. Barnet, president; W. DeWoody Dickinson, Jr., vice-president; and A. C. Austin, secretary-treasurer. At the **Vicksburg Branch's** first luncheon meeting of the year M. G. Spangler, research professor at Iowa State College, described some of his experiences in soil foundation studies and consulting work. Professor Spangler is on the Board of Consultants for the Waterways Experiment Station at Vicksburg. Frank Redus is current president of the Branch.

A talk by Fred S. Poorman, deputy commissioner of the Public Buildings Service, highlighted the **National Capital Section's** regular monthly meeting on January 8. Speaking on "The Place of the Engineer in the Maintenance of Real Property," Mr. Poorman discussed problems the PBS must solve in the design, construction, maintenance, and repair of public buildings. Mr. Poorman noted that since the end of the war the appropriations for this vital agency "have been at an irreducible minimum." At the present time it is operating at about 23 percent below adequate standards, and its backlog of deferred maintenance is estimated at $80,000,000. Mr. Poorman said PBS has developed a program for major repair or replacement of all temporary and substandard buildings in the District of Columbia.

Nebraska is the only state which has not qualified for federal assistance for a water pollution control program. Federal funds are available to support a program on a matching basis, but the state appropriates no funds for pollution control activities. These and other facts were brought out at the **Nebraska Section's** January meeting by featured speaker Glen J. Hopkins, regional engineer for the U. S. Public Health Service at Kansas City, Mo. It must be recognized, he said, that the primary responsibility for controlling pollution rests with the states. "Perhaps above all," he concluded, "Nebraska needs a new pollution control law." During the evening Paul C. Benedict, an employee of the U. S. Geological Survey at Lincoln, was elected president to succeed Wendell E. Johnson. Kenneth B. Lucas is new senior vice-president, and Nathaniel Beezley junior vice-president.

Two Life Membership Certificates were awarded at the **Oregon Section's** annual meeting in January. The recipients were Norman B. Conway and Frank D. Talbott, both of Portland.

The **Trenton Branch** of the **Philadelphia Section** announces its new roster of

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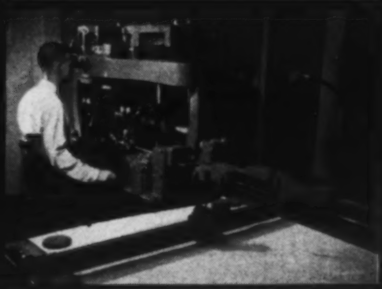

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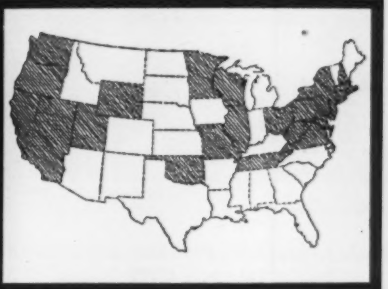

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View of head table at Los Angeles Section's first meeting of the new year are (left to right) Alfred E. Waters, treasurer of the Section; Samuel B. Nelson, secretary; Harald Omsted, vice-president; N. D. Whitman, Jr., president; Dean E. Stephan, vice-president; and Louis J. Alexander, past-president. Absent were Past-President George E. Brandow and James R. Davis, Junior Member Forum representative. Featured speaker was Edward T. Telford, assistant California state highway engineer, who discussed the speedup in developing the state highway and freeway system resulting from recent federal legislation providing funds for the purpose.

Among dignitaries attending Mid-Missouri Section's January meeting are (left to right) Daniel Kennedy; ASCE Director William Hedley; Norman Moore, Vice-President of the Society; ASCE President Mason Lockwood; Prof. E. W. Carlton, former Director; Dr. Adrian Pauw, president of Mid-Missouri Section; William Riddle, president of Kansas City Section; Garvin Dyer, president-elect of the National Society of Professional Engineers; and Prof. Leon Hershkowitz, vice-president of Mid-Missouri Section and Faculty Adviser to the Student Chapter at the University of Missouri School of Mines and Metallurgy. Mr. Lockwood was featured speaker.

officers: Carl Gaum, president; Morris Ojalvo, vice-president; and H. W. Acken, secretary-treasurer. R. L. Hardman is councilor for 1957, and R. K. Bernhard for 1958. Construction of the New York Shipbuilding Company's new drydock at Camden, N. J., was the featured subject at a recent Branch meeting, addressed by George Vaccaro, of Parsons, Brinckerhoff, Hall and Macdonald. This installation, which measures 1,100 ft long by 150 ft wide, was built inside an enclosure of cellular cofferdams. The bottom concrete slab, 28 ft thick along the centerline and 22 ft thick along the sides, is designed to act as a cantilever. Wedging action of the cellular cofferdam sides will partially compensate for uplift. Earlier drydocks, Mr. Vaccaro said, were hydraulically compensated, with uplift relieved by pumping.

In the **Sacramento Section** the new slate is Ralph W. Hutchinson, president; Irvin M. Ingerson, first vice-president; Frank L. Howland, second vice-president; and J. C. Obermuller, secretary. Three Section members were honored with Life Membership Certificates at the December meeting. They are Walter E. Stoddard, Oswald Speir, and S. Harry Scarancke. Heading up the Section's **Junior Forum** are Charles G. Wolfe, president; William B. Shaw, vice-president; and Lawrence A. Mullnix, secretary-treasurer. New **Marysville Branch** officers are George W. Reed, president; Donald W. Danielson, vice-president; Walter A. Whitnack, secretary; and Edward M. Wall, treasurer.

From the vantage point of being mayor of St. Louis, the Hon. R. R. Tucker ably discussed "The Engineer in Public Life" at the **St. Louis Section's** annual meeting on December 7. Other speakers were Directors Don M. Corbett and William J. Hedley, reporting for Districts 9 and 14. Life Membership Certificates were awarded to Harry E. Frech and, in absentia, to Ernest H. Paffrath. At the end of the year the Section had chalked up 416 meetings.

How the engineer should work with the soils engineer was discussed in the featured talk at the **San Diego Section's** January meeting. The speaker was Vernon A. Smoots, resident partner in charge of the Los Angeles office of Dames & Moore. Developing the topic, "Foundation Investigations and Soils Mechanics Engineering," Mr. Smoots showed slides illustrating many different soil problems and design criteria. R. C. Clark gave a brief impromptu talk on the San Diego Highway Development Association, which has for its aim more and better highways for San Diego County.

James T. Pott, who is in the engineering office of Clyde C. Kennedy, has been appointed 1957 editor of the **San Francisco Section's** distinguished newssheet, "The Civil Engineer." Mr. Pott, a former assistant editor, succeeds Edwin A.

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First name in whiteprinting

Wells, Jr. Life Membership Certificates went to seven Section members at a dinner meeting held in December. Honored were Frank E. Bonner, Robert M. Copeland, John R. Fox, Harry P. Hart, Herbert J. King, Samuel P. Laverty, and Charles M. Romanowitz. The presentations were made by S. T. Harding, former Society Director and Section president. Mr. Harding also presented the Arthur Wellington Award to the co-recipient, John Hugh Jones, who was unable to attend the Pittsburgh Convention last fall when the other Society prizes were presented.

At its annual winter meeting in Columbia, S. C., on January 11, the **South Carolina Section** elected new officers: B. P. Barber, president; Marcus B. Hunder, vice-president; and Albert E. Johnson, secretary-treasurer. The two latter were elected to two-year terms. The day-long meeting—a joint program with the South Carolina Society of Engineers—consisted of two technical sessions, a luncheon, business meeting, and banquet. Featured speakers were Harry E. Stark, design engineer for the U. S. Bureau of Public Roads, at Atlanta, who discussed the new highway program; H. Winston Davis, deputy manager for the Savannah River Operations Office of the AEC, whose paper covered industrial applications of atomic energy; and C. S. Reed, vice-president of the Duke Power Company, Charlotte, N. C., whose paper was entitled "Times Are Changing."

New Mohawk-Hudson Section officers are (left to right) Holbert W. Fear, treasurer; C. S. Barton, first vice-president; Harold B. Britton, president; Edward L. Barry, secretary; and Haaren A. Miklofsky, second vice-president. The slate was introduced at the Section's annual meeting held at Latham, N. Y. The meeting was highlighted by a talk by E. W. Dennis, director of the Biology Division, Sterling Winthrop Research Division, Rensselaer, N. Y. Life Membership Certificates were presented in absentia to Elroy W. Bently, E. G. Larson, and Leo Baker.

In Tacoma Section's first annual Technical Paper Competition for Junior Members (February issue, page 74) Hollis R. Goff (second from right) received a scroll and cash prize. Shown with him (left to right) are Fred M. Veatch, member of Award Committee; Harold F. Sitts, incoming president of Section and chairman of Awards Committee; Mr. Goff; and George H. Andrews, member of the Award Committee.

The **Tennessee Valley Section** has the distinction of being the first to establish an exclusively civil engineering senior scholarship at the University of Tennessee. The new scholarship will provide $400 a year for a senior in civil engineering, with high scholastic record and definite interest in a civil engineering career after graduation. The first winner will be announced this spring, when the nine other senior awards are made known.

At the helm of the **Tri-City Section** this year are Charles H. Welker, president; James R. Swanson, vice-president; and Donald C. Davis, secretary-treasurer. Executive Secretary William H. Wisely was guest of the Section and principal speaker at the December meeting held in Davenport, Iowa. His talk covered many features of headquarters operation.

The **Toledo Section** has also elected new officers. They are Rehman P. Scholz, president; William J. Gross, second vice-president; and Leo V. Campbell, secretary-treasurer. Alfred E. Picardi was automatically advanced to the office of first vice-president.

In the **Virginia Section** the new panel is James A. Rives, president; Stanley R. Navas, Charles E. Via, Jr., and Livingston Smith, vice-presidents; Frank G. Louthan, Jr., secretary; E. L. Coile, treasurer; and Stuart Loughborough, assistant secretary. Stuart H. Poore is president of the **Richmond Branch**; A. W. Maner, vice-president; and Raymond S. Gordon, secretary. In the **Norfolk Branch** the slate is Thomas B. Hutcheson, president; Rear Admiral William Sihler, vice-president; and J. W. Midkiff, Jr., secretary. **Roanoke Branch** officers are Raymond F. Watson, president; Byrd H. Barksdale, vice-president; and C. T. Tomlin, secretary.

HOW TO HANDLE WET JOBS

#36 of a Series

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BY-LINE WASHINGTON . . . . .

The National Highway Program held the spotlight in Washington last month in the parade of legislative activities:

The Senate approved the appointment of Bertram D. Tallamy, President Eisenhower's choice of first permanent Federal Highway Administrator. The former New York Thruway chief will boss the largest public works construction assignment ever undertaken. The Senators expressed sound confidence in Mr. Tallamy, wished him well in the grandest internal improvement program of the century.

A Senate Subcommittee inquiry into the progress of the $50-billion federal-aid road program revealed that about as good a start has been made as could be expected. John Volpe, interim administrator, is credited with getting the program off the ground. He told the Senators that:

» $6½ billion will have been apportioned to the state highway departments by July 1, the end of the first year of the new road construction program. This is more money than has been apportioned in any previous 14-year period.

» More than $1 billion has been obligated for specific jobs on the Interstate System, and the next few months will see that figure multiplied considerably.

* * *

The highway program will not be delayed by lack of steel, representatives of that industry insisted before the Senate investigation. Clifford F. Hood, president of United States Steel Corporation, declared he knew "of nothing in the steel picture that should impede this orderly progress" of the program.

* * *

Meanwhile, a big step has been taken to reduce the work load involved in bridge design and to save vital materials. The Bureau of Public Roads has developed 18 series of standard plans, including three new series for pretensioned precast concrete structures and five series for structural timber structures.

The designs are for two widths of roadway—24 ft with H-15-44 live load and 28 ft with H20-S16-44 live load—and for span lengths from 11 to 140 ft. The publication, "Standard Plans for Highway Bridge Superstructures (1956)," is available from the U. S. Government Printing Office, Washington 25, D. C.

* * *

Some $1.8 billion worth of engineering work is at stake in an omnibus rivers and harbors and flood control bill up for consideration in Congress again this session. President Eisenhower vetoed an identical measure passed by both houses last year, on the grounds that Corps of Engineers reports for some of the projects had not been completely processed. With those objections removed, the bill is again working its way through committee.

Reporting progress in the *flood-control program* thus far, the House Committee on Public Works has cited 760 projects with an estimated cost of $6.3 billion. The addition of multiple-purpose projects with flood control features brings this to $9.5 billion, of which $5.5 billion remains yet to be appropriated.

The *rivers and harbors improvement program envisions* 2,300 navigational projects at an estimated cost of $4.3 billion. The addition of multiple-purpose projects, which serve navigational purposes, boosts this sum to $6.5 billion, of which $3.3 billion remains yet to be appropriated.

Congressmen appear confident that the current bill authorizing $1.8 billion for both programs will be acceptable to the Administration this year.

* * *

A bill to provide supplementary salary grants to engineering professors has been introduced by Congressman Elmer J. Holland. Its objective: To encourage such teachers to continue in their vital tasks of helping build up the nation's reservoir of engineers. Congressman Holland would like to see the federal government supplement the salaries of engineering professors sufficiently to boost their income to those of engineers in private industry. He is interested, also, in the creation of scholarships and fellowships to aid students in engineering colleges.

* * *

The work of the White House Committee on Engineers and Scientists for Federal Government Programs was outlined recently by Philip Young, U. S. Civil Service Commissioner. The committee is now completing its fact-finding studies, initiated to discover how extensively the federal government uses engineers and how it can compete with private industry for talent.

Among other things, the committee will investigate Uncle Sam's recruitment practices, pay system, and other incentives. Mr. Young believes that the federal government must relax its rigid civil service restrictions to enable it to add qualified men to its agency staffs. The grade-and-salary structure, the pay ceiling, and the number of top-grade positions are too limited, he said.

The federal government currently employs more than 43,000 professional engineers in 40 specialties.

* * *

Both House and Senate subcommittees are preparing to investigate delay in the federal government's big building program involving numerous proposed post offices and other federal structures around the country under the lease-purchase procedure launched several years ago. Congressman Jones of Alabama, chairman of the House Subcommittee on Public Buildings, reported that of 150 projects already approved by Congressional committees only one has been let to contract. Officials of both the General Services Administration and the Post Office Department will be asked to explain why more contracts have not been awarded for this type of construction.

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On your next bridge or overpass, design for rugged beauty plus economy . . . design for REINFORCED CONCRETE.

A southerly view of a recently completed section of the Harbor Freeway, U. S. Highway 6, Los Angeles

Designed by the California Division of Highways

Contractor: Winston Bros., Monrovia, California

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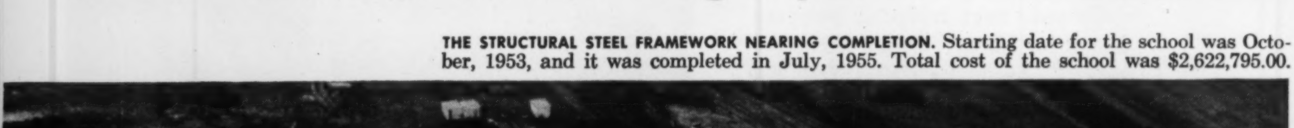
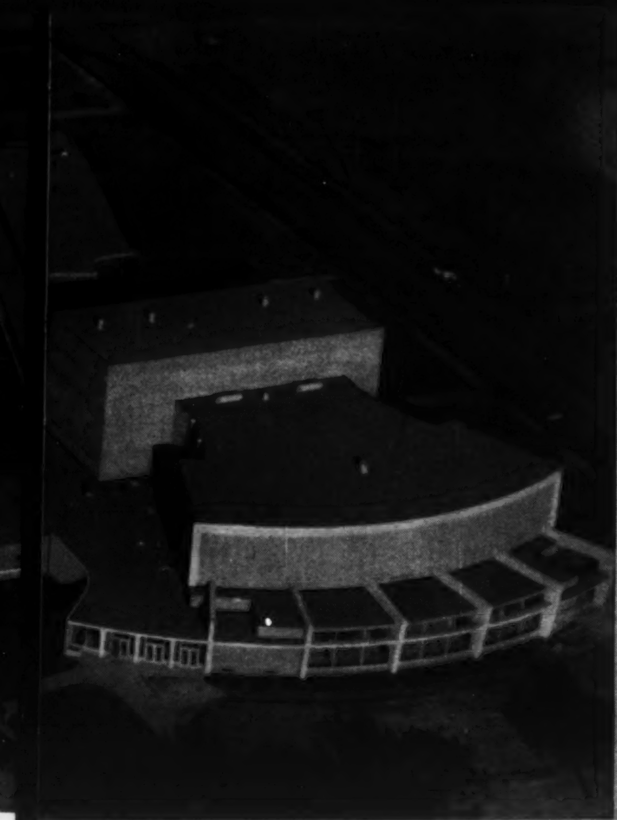
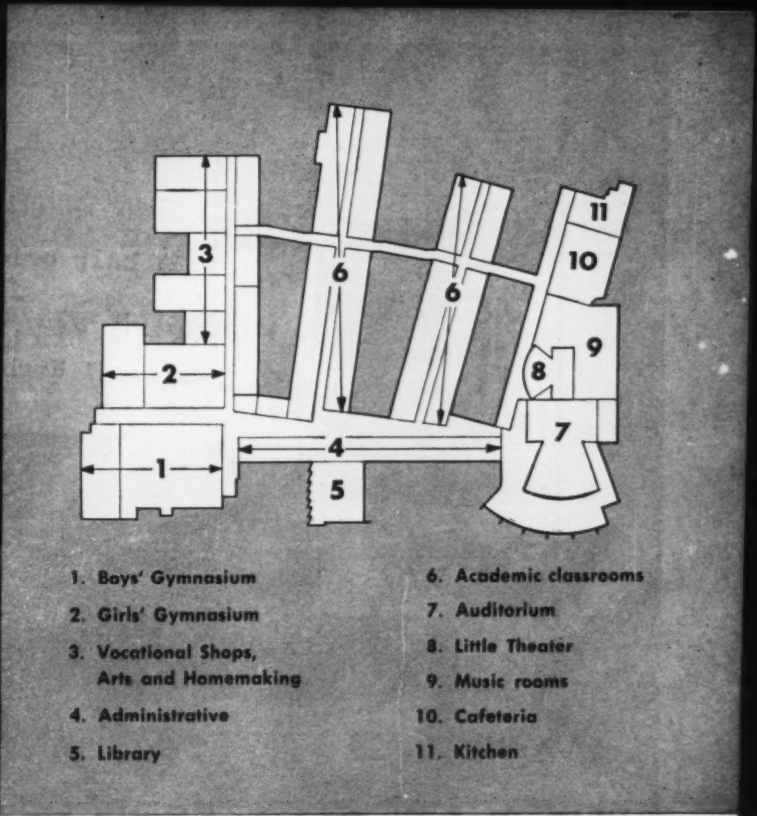
Functional, economical "finger plan" of Grand Island

THE STRUCTURAL STEEL FRAMEWORK NEARING COMPLETION. Starting date for the school was October, 1953, and it was completed in July, 1955. Total cost of the school was $2,622,795.00.



UNITED STATES STEEL





High School *again illustrates versatility of Structural Steel!*

The basic design of the new senior high school in Grand Island, Nebraska, consists of four "fingers," or wings, containing classrooms, radiating from a main administrative area. The "fingers," which extend toward the west, are oriented at slightly different angles from each other in order to secure the best lighting and ventilating situations. And, in addition to being connected to the administration area, each "finger" is joined to the others by means of a corridor—for quick passage from one wing to another. The school is sized to accommodate approximately 1,400 students. All areas are of one-story construction.

The unique building houses two gymnasiums, one of which will seat 2,600 spectators for varsity basketball games. The main auditorium will accommodate 1,500 people comfortably, and the Little Theater can seat 300. In both, stages are equipped to handle even the most intricate of productions. The ultramodern cafeteria, which turns out 600 to 700 meals with ease during the short lunch period, may be converted quickly into a study hall through the use of motorized rolling doors. The whole effect of the school is one of efficiency coupled with luxury. Yet, it was built at a cost of only $10.96 per square foot.

Approximately 1,017 tons of Structural Steel were used in the framework of the new building—contributing greatly to the economy of construction. As is usually the case, when economy must go hand-in-hand with imaginative architectural ideas, Structural Steel is called upon. And why not? Structural Steel is versatile. It's the strongest, most economical of load-carrying materials—effectively resists tension, torsion, compression and shear. Once enclosed in buildings, it lasts indefinitely, requiring no maintenance. Structural Steel may be riveted, bolted or welded, and may be erected in any weather. And since steel members are fabricated indoors, weather can have no effect on the quality of workmanship. For further details, return the coupon.

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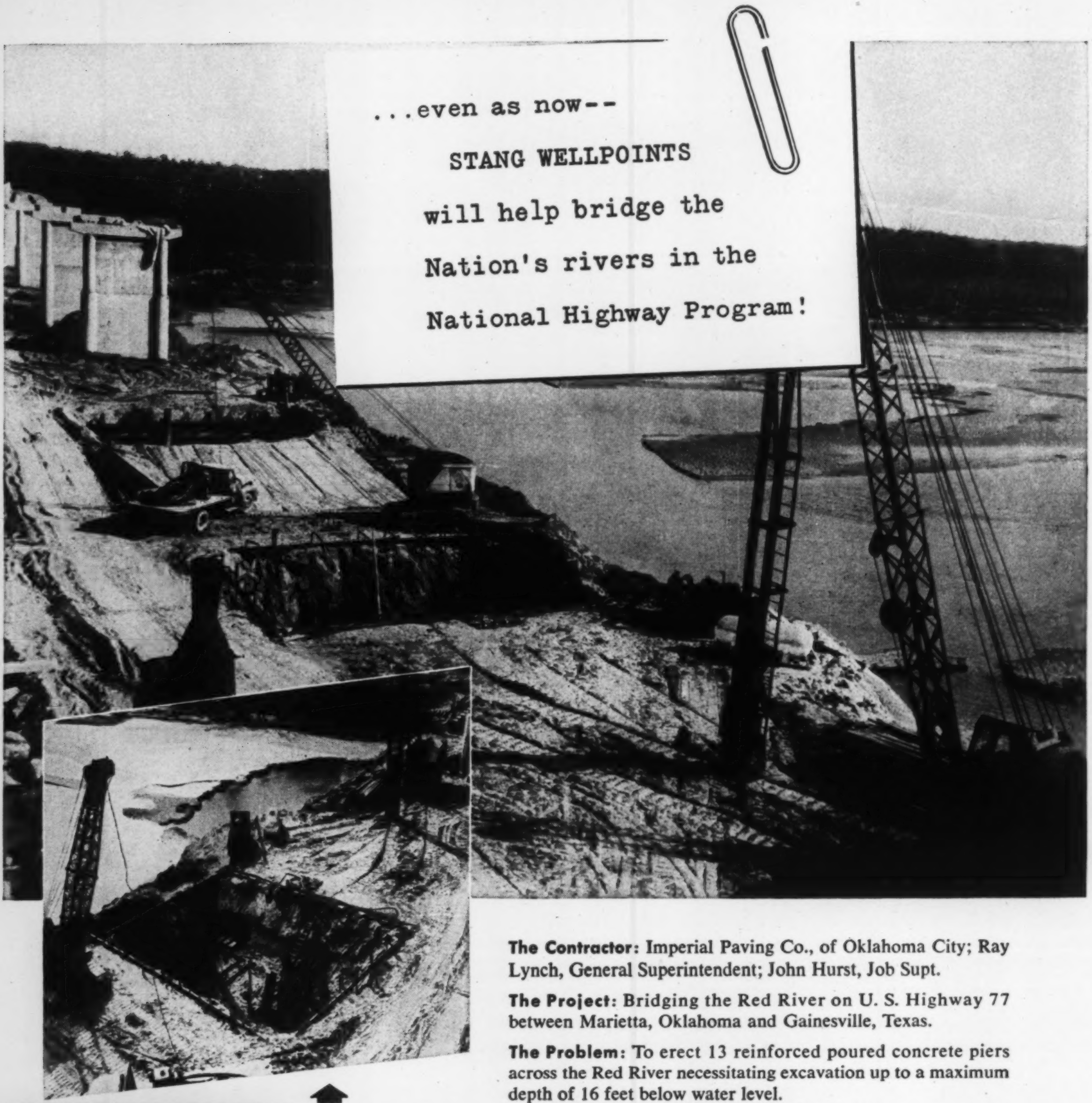

The Red River bridge is a joint Texas-Oklahoma project under the direction of the Texas Highway Department, Mr. John G. Simpson, resident engineer.

The Contractor: Imperial Paving Co., of Oklahoma City; Ray Lynch, General Superintendent; John Hurst, Job Supt.

The Project: Bridging the Red River on U. S. Highway 77 between Marietta, Oklahoma and Gainesville, Texas.

The Problem: To erect 13 reinforced poured concrete piers across the Red River necessitating excavation up to a maximum depth of 16 feet below water level.

The Solution: Installing a Stang Wellpoint system progressively around each pier location on a previously constructed earthen dyke thus lowering the ground water level to the required depth.

Result: A completely dry working area in a water-saturated riverbed making possible a *time-saving and profitable job!*

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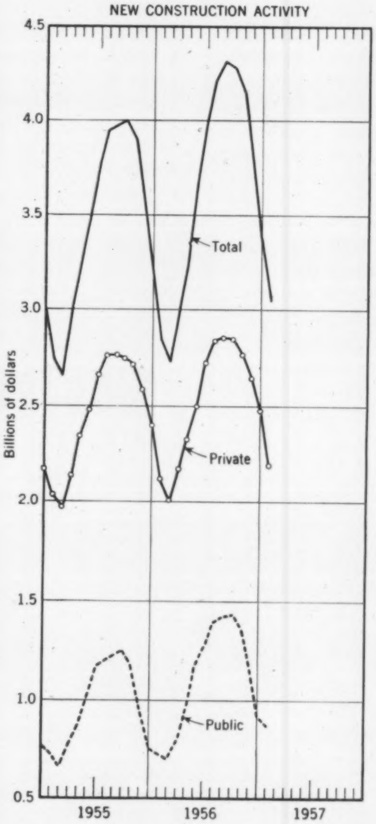
NEWS BRIEFS . . .

January Construction Activity at New High for Month

Although new construction activity declined seasonally in January to $3.0 billion, it exceeded by 3 percent the previous January record set in 1956, according to preliminary joint estimates of the U. S. Departments of Commerce and Labor. On a seasonally adjusted basis, outlays for new construction last month were at an annual rate of $44.8 billion, compared with actual expenditures of $44¼ billion in 1956.

Private construction declined 12 percent during the month, reflecting a slightly more than seasonal decrease in both residential and nonresidential building. The $2.2 billion in total private expenditures, however, equalled the previous January high attained in 1956, with declines in housing, stores, and farm buildings offset by over-the-year rises in the other types of private construction. New January records were set in outlays for industrial plants, office buildings, churches, schools, hospitals, and public utilities.

Public construction expenditures, in total, showed a less than seasonal decline of 4 percent from December, as new January highs were chalked up in outlays for public schools, and sewer and water projects. All public construction except industrial contributed to the 12 percent increase over January 1956.



January construction expenditures, at $3.0 billion, represent seasonal drop from December but exceed by 3 percent previous January record set in 1956.

Employment of Consultants in Federal-Aid Program

A recent memorandum to division and district engineers in the Bureau of Public Roads from John A. Volpe, then Federal Highway Administrator, is reprinted here for the information of consultants interested in participating in the new highway program.

The Federal-Aid Highway Act of 1956 imposes on the state highway departments, when added to their other work, the heaviest work loads ever undertaken over a long period of time. During hearings on the bill the question of the ability of the highway departments to competently supervise and adequately engineer the job was explored at great length, and it was decided that the highway departments could be depended upon to do the job.

The basic Federal Highway Act of 1921 and subsequent acts, together with the regulations issued pursuant thereto, have always contemplated that a state highway department adequately organized and equipped is available to cooperate with the Bureau [of Public Roads] as a requisite of the state's participation.

In order to cope with unusual situations requiring engineering services not ordinarily needed and therefore not available in a well-constituted state highway department, as well as to permit a temporary augmenting of the regular state highway department staffs to meet occasional peak work-load surges, the use of some outside staff from qualified consulting firms has been regularly approved for individual projects over a number of years.

With the long-term character of the Federal-Aid Highway Act of 1956 and its known annual authorizations over a 13-year period, it is felt that we must not place major reliance on outside assistance, but rather that proper state highway department organization within the meaning of the basic federal-aid acts requires states to provide adequate staffing with employees giving full-time service to the program, except for unusual and special situations not regularly recurring. The present urgency to expand the program understandably makes necessary the utilization of engineering services from almost every possible source. It is felt, however, that such a need for outside services should not be continued over an extended period. We expect that state officials will make any adjustments that may be needed to develop at the earliest possible date satisfactory organizations that will unquestionably comply with the basic provision of the law.

All contracts for engineering services from consultant firms proposed for participation in federal-aid funds in the future and submitted so as to be received in the Bureau offices on and after January 15, 1957, shall contain the following clause:

> "The consultant warrants that he has not employed or retained any company or person, other than a bona fide employee working solely for the consultant, to solicit or secure this contract, and that he has not paid or agreed to pay any company or person, other than bona fide employee working solely for the consultant, any fee, commission, percentage, brokerage fee, gifts, or any other consideration, contingent upon or resulting from the award or making of this contract. For breach or violation of this warranty the state shall have the right to annul this contract without liability."

In order that all plans prepared by consultants for Interstate System projects shall meet the requirement for uniform application of standards throughout the System, an appropriate clause shall also be included in all such contracts. The clause shall make reference to the standards adopted by the AASHO and approved by the Secretary of Commerce as provided in Section 108 (*i*) of the Federal-Aid Highway Act of 1956 and require the consultant to prepare plans and any other items pertaining thereto in accordance with such standards.

To afford state highway departments

the maximum of opportunity to develop and retain adequate engineering staffs, it is recommended that the following clause be made a part of such agreements for engineering services, and an appropriate amendment is being made in the Outline of Provision and Clauses for Engineering Contracts attached to PPM 40-6:

"The consultant shall not engage, on a full- or part-time or other basis during the period of the contract, any professional or technical personnel who are or have been at any time during the period of the contract in the employ of the Bureau of Public Roads or the highway organization of any state, county, or city, except regularly retired employees, without the written consent of the public employer of such person."

It is expected that the Bureau of Public Roads and the state, county, or city will not give its consent under the above-suggested clause to permit the consultant to engage the services of any of its professional or technical employees, if such consent would in any way impair the adequacy of the highway organization or effectiveness of highway operations of such organization.

Hungarian Refugees with Professional Training

In cooperation with the President's Committee for Hungarian Refugee Relief, the National Academy of Sciences has established an office at Camp Kilmer, N. J., to help identify and place persons with advanced scientific, engineering, or other professional training. Vice-President Nixon recently reported that more than 1,000 of the 9,253 who had arrived in this country by December 31 are "professional, technical, and kindred workers." It is expected that this proportion also exists among those who have arrived since the end of the year and in the continuing groups of immigrants.

The Council (2101 Constitution Avenue, Washington 25, D. C.) will be glad to be advised of openings for persons of advanced training in any field of scholarship or the professions, particularly openings that require the doctorate or an advanced engineering degree. Because of the limited facilities at Camp Kilmer it is necessary to place the refugees as soon as possible. An effort will be made to bring openings to the attention of all persons who appear to be qualified and to give each individual an opportunity to consider a variety of employment possibilities. Many of the refugees who do not speak English know French or German.

National organizations, including the American Council for Emigrés in the Professions, are cooperating with the National Research Council in placing the arrivals.

Venezuela Dedicates World's Longest Earth Dam

Irrigation for more than 300,000 acres of arid land will be provided by nine-mile-long Guarico Dam, wihch has just been completed in Venezuela. Built in two years, the $65,000,000 project stores water in a 94-sq mile lake and then feeds it through 290 miles of canals to the lands below. Economists expect that the project will increase productivity by 540 percent. Where a century ago millions of head of cattle grazed, there has been no grazing in recent years because of perpetual summer drought and winter floods. Part of the Venezuelan government's program of "sowing the petroleum wealth back into the soil," the project will provide land for both cattle raising and general farming. This photo shows the dam just after Gen. Marcos Perez Jimenez, president of Venezuela, pushed a button opening the sluice gates. Photo courtesy of Hamilton Wright.

ABRA Holds Annual Convention During Road Show

Not all the interest of roadbuilders was centered on the ARBA Road Show and its staggering display of construction equipment. Four days of discussion centered on the engineering and planning aspects of accomplishing the mammoth national road program marked the ARBA annual convention. The Hon. Dennis Chavez, chairman of the Senate Public Works Committee, summarized the legislative program relating to highways which envisioned within the next few years:

1. Consideration of needs for additions to interstate mileage.

2. Consideration of needs for accelerating primary, secondary, and urban projects.

3. Possible rescheduling of priorities for construction of total system of highways to provide most economic and useful arterial highways. This should be done only after a complete evaluation is made by federal and state highway officials.

4. Review and approval of reports dealing with apportionment of funds among states on the "needs" basis.

5. Review of present law on maximum weights and dimensions with possible amendment, depending on what studies now completed and under way will show.

6. Determination of the manner and degree to which states will be reimbursed for roads now constructed.

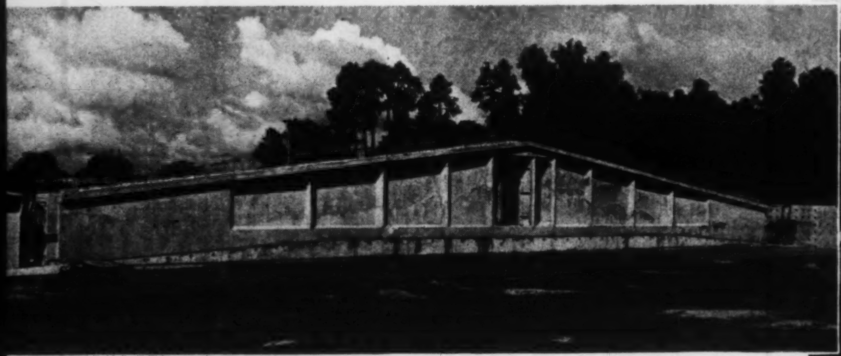
7. Study results of safety research programs and determine whether federal legislation is needed or not.

8. Determine the advisability of assessing federal taxes among persons using the federal-aid highways in proportion to benefits derived or uses made thereof.

Other topics up for discussion included the design of rigid pavements; careers for young highway engineers; financing of the road program; and methods for speeding up highway engineering, earthmoving, and compaction of soils. Many committee sessions were devoted to the various facets of highway construction and administration.

The new president of the ARBA is Julien R. Steelman, president of the Koehring Company. Clarence E. Killebrew, vice-president of the Clark Equipment Company, was elected president of the CIMA (Construction Industry Manufacturers Association).

Large Prestressed Girders Readied for Florida Project



Some of the largest prestressed girders ever cast (large photo) are rolling along Florida highways to the American Cyanamid plant at Brewster. Ordered for the construction of a triple superphosphate storage warehouse, the girders were cast by Prestressed Concrete Inc., at Lakeland, in special Form-Crete steel forms supplied by Florida Division Food Machinery & Chemical Corp., Lakeland. Lakeland Engineering Associates are responsible for the design and engineering work. Each of the girders is 101½ ft long with a height of 12 ft at the center tapering to 4 ft at the ends. Weight of each is 71 tons. Small view pictures forms in place and shows the 48 prestressing cables and reinforcing steel (2½ tons of it) required for each of the 33 girders.

Designs for Los Angeles Treatment Plant Completed

All principal designs for the City of Los Angeles' $40,700,000 Hyperion Sewage Treatment Plant expansion and modification program were completed by the end of the year. This announcement comes from David L. Narver, Jr., project manager of Hyperion Engineers, the organization chosen by the Board of Public Works to handle the engineering design. Hyperion Engineers is a joint venture consisting of three Los Angeles firms—Holmes & Narver, Inc.; Daniel, Mann, Johnson & Mendenhall; and Koebig and Koebig.

Much of the construction work for the vast project has already begun. Two contracts totaling $11,127,000 have been let for construction of eight miles of main trunk line sewer, known as the North Central Outfall sewer. This sewer, which is 9½ ft in dia, will include 5.4 miles of tunnel and 2.6 miles of open cut. Construction of a sludge ocean outfall, for which a $2,629,044 contract has been awarded, is scheduled for completion in October. This 2-ft-dia pipe will extend almost seven miles out to sea, terminating in 300 ft of water.

Largest of the jobs still to be let include a 12-ft-dia effluent outfall, which will extend more than five miles into the sea, and a plant-enlargement program including new primary settling tanks, headworks building, and the remaining 1,500-ft section of the North Central Outfall Sewer. Engineers estimate construction costs of the effluent outfall as high as $18,000,000. The plant enlargement, which is estimated to cost $4,045,000, will increase plant capacity 50 percent.

Paraguay to Have Modern Water System

Asuncion, capital city of Paraguay, will have a complete new water supply and distribution system. Work on the project started in December, following the award of a construction contract by Corporacion de Obras Sanitarias (a Paraguayan government agency) to Kaiser Engineers International, Inc. The largest single project ever undertaken in Paraguay, the contract includes four pumping plants, a water treatment plant, four reservoirs, and a water distribution system for the city of 250,000. The project is being financed with an Export-Import Bank loan of about $7,000,000, plus an additional $2,000,000 provided by the Paraguayan government. Completion is scheduled for the end of 1958.

Wright M. Price has been appointed resident manager of construction, and R. J. Rice will handle coordination of the Asuncion project at the Oakland, Calif., headquarters of Kaiser Engineers.

Kingston-Rhinecliff Span Is Opened to Traffic

Formal opening of the $19,000,000 Kingston-Rhinecliff Bridge across the Hudson River took place on February 2 in ceremonies headed by Governor Averell Harriman. The high-level steel structure, located about midway between the Poughkeepsie and Catskill bridges, features twin-deck continuous truss units of 500-, 800-, and 500-ft spans centered over the two navigable channels. Each channel unit is flanked on the shore side with one 300-ft single-truss span plus approach girder spans. The truss spans are supported on eight reinforced concrete river piers varying in height from 129 to 194 ft above the water. The 36-ft roadway rises on a 5,200-ft vertical curve to an elevation 253 ft above the water at midspan. Approach roads connect with Route 9G on the east and with Route 32 on the west side.

Construction started July 1954, with the Merritt-Chapman & Scott Corp. as substructure contractor and the Harris Structural Steel Co. contractor for the superstructure. D. B. Steinman, M. ASCE, consulting engineer of New York, designed the bridge and approach roads and supervised the construction, with W. E. Joyce project engineer. The bridge is owned and operated as a toll facility by the New York State Bridge Authority.

Government Reviews Construction in 1956

Construction costs, employment, and wages rose to record levels in 1956, while supply of and demand for construction materials were more nearly in balance than in any of the past several years, according to an article in the current *Construction Review*, a joint publication of the Departments of Labor and Commerce. The most important movements in construction last year, the joint report states, were contrasting: a sharp drop in private housing activity from the extraordinary levels of 1955, and expansion in industrial and other business capacity to new highs.

Because of large-scale gains in productive capacity, construction materials—with the exception of steel—were in adequate supply for the first time since 1950. Even in the light of expanding highway programs fear of a general cement shortage was dispelled. In addition, by the end of the year, producers of many key materials were making moderate downward adjustments in production schedules in response to the decline in housing activity.

The 5 percent rise in construction costs between 1955 and 1956 was the sharpest in five years. However, costs tended to stabilize late in the year, reflecting principally declining prices of lumber and softwood plywood. By the end of the year, the building materials wholesale price index was only 2 percent above the level of the previous December. The prices of all building materials other than lumber and plywood increased during 1956, and significant advances occurred in other components of construction cost. For example, the prices of construction machinery and equipment rose 8 percent. Hourly earnings of workers on contract construction increased almost 5 percent. Union wage scales in the building trades (seven trades in 100 cities) rose more in 1956 than in 1955, and adjustments were much more prevalent among the trades and cities covered.

According to the joint article, "employment by construction contractors expanded in 1956 to an all-time peak of 3,353,000 workers in August, and for the year as a whole, averaged about 3,000,000 per month." All regions of the country and all major classes of construction showed employment gains.

With both public and private non-residential construction at record levels, and with other parts of the economy operating at or near peak, unusual pressures were placed on the money market. The article sketches the effect of these pressures, particularly on housing activity, and shows the steps taken during the year to increase the flow of mortgage funds. It also analyzes the differential rates of federal, and state and local, public construction and of business plant expansion in 1956—industrial, commercial, and public utility.

The *Construction Review* may be obtained by subscription from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for $3 a year (domestic) or $4 foreign. Single copies, at 30 cents each, may be purchased from Department of Commerce field offices or the Bureau of Labor Statistics regional offices.

New Home for the AGC

Progress in planning a new headquarters building in Washington, D. C., for the Associated General Contractors of America is reported by AGC President Frank J. Rooney. The exterior of the three-story and basement building will be buff Indiana limestone with harmonizing trim—in keeping with the large number of new federal buildings in the northwestern section of the city, site of the new headquarters building. Working drawings are being prepared by the architectural firm of Chatelain, Gauger & Nolan, Washington.

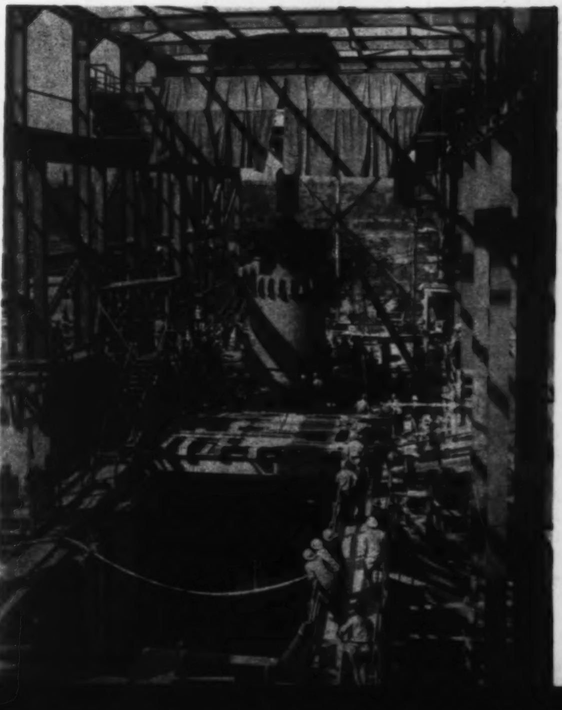
The time schedule for the new building calls for ground-breaking ceremonies during the association's 28th annual convention in Washington, March 11-14, and occupancy in the summer of 1958.

AICE Officers for 1957

Edward H. Anson, M. ASCE, vice-president and director of Gibbs & Hill, New York, has been elected president of the American Institute of Consulting Engineers, succeeding ASCE Past-President Carlton S. Proctor, also of New York. Others elected to the governing council are E. Sherman Chase, Metcalf & Eddy, Boston; Dean G. Edwards, M. ASCE, Edwards, Kelcey and Beck, Newark, N. J.; and Emil H. Praeger, M. ASCE, Praeger & Kavanagh, New York.

The Institute was organized in 1910 to ". . . advance the interests of engineers in all branches, particularly those of consulting engineers, and to increase the usefulness of the profession to the general public."

Installing Atomic Reactor at Shippingport Plant



In installing the atomic reactor vessel at the AEC-Duquesne Light Company's Shippingport (Pa.) atomic power station, the Dravo Corporation and Westinghouse engineers had to meet the challenge of handling the extremely heavy unit with a watchmaker's tolerance. The 153-ton steel vessel, which will ultimately house the reactor, was moved by overhead crane from a flat car to a point directly over the opening of the underground reactor sphere and then lowered 35 ft into the sphere (as shown in the photo). Next it was attached to a specially constructed 15-ton suspension system, where it will remain suspended until the necessary insulating walls can be built around it. Finally it will be lowered an additional 5 ft and made fast to permanent supports. The actual move from flat car to sphere opening took more than an hour, and the shift from crane to suspension rigging nine hours. Previously Dravo workmen had spent nine days testing crane and rigging with successively heavier loads of 6 1/2-ton steel ingots until the final test of 245 tons was made.

Construction Men Honored at Beavers Dinner

Recipients of Golden Beavers Awards are (left to right): Lt. Gen. Samuel D. Sturgis, Jr., Ben Arp, Augustine H. Ayers, W. J. Rohan, Robert B. Diemer, Otto W. Peterson, Edwin M. Whipple, A. J. Cook, A. F. Garlinghouse, and W. E. Kier.

Eleven men prominent in the Western construction industry were honored at the second annual Beavers Golden Awards Dinner held in Los Angeles on January 17. Among those cited for "outstanding contributions and meritorious service" in the industry were the following members of ASCE: Augustine H. Ayers and Otto W. Peterson for engineering; A. F. Garlinghouse for supply; Lt. Gen. Samuel D. Sturgis, Jr. and Robert B. Diemer for special service to the industry. Over 900 attended the dinner, at which Abel Wolman, M. ASCE, professor of sanitary engineering at Johns Hopkins University, spoke.

New Beaver officers, elected during the evening, are George H. Atkinson, president; John A. Kier and John M. Sawyer, M. ASCE, vice-presidents; J. P. Shirley, Jr., M. ASCE, secretary-treasurer; J. W. Watson, assistant secretary-treasurer; and James L. Lovell, ambassador of good will.

Established last year, the association includes most of the heavy engineering companies west of the Mississippi as active members and other companies, which stand in a service-supply relationship, as associate members.

Serious Lag in Sanitation Salaries Reported

Failure of local health departments by substantial margins to pay the going price for competent personnel in environmental health services is resulting in a growing shortage, especially of engineers. Recruitment problems facing the departments are reflected in the first of five reports by the Committee on Salaries of the Conference of Municipal Public Health Engineers.

The committee surveyed the salaries of engineers, sanitarians, sanitary inspectors, veterinarians, and other environmental health personnel in 371 full-time local health departments. Its report shows the rise in salary levels from 1951 to 1956. According to the report, salaries have been rising steadily at rates varying from 5 to 13 percent each year, but they fail to match those paid in similar professional categories outside health departments.

Salaries for engineers are well below those paid to other members of the profession. In 1952-1954, the median salary was $1,000 below the median for county and municipal engineers and $2,400 below the median for all engineers. Under the circumstances, the number of unfilled engineering positions in local health departments is increasing rapidly.

In 1956 starting salaries in local health agencies for engineers with no experience ranged from $4,250 to $4,650. The same year engineering schools reported a median starting salary of $5,040 and predicted that their 1957 graduates will expect around $5,250. In addition to paying higher salaries, private employers tell the young engineer that his interview and moving expenses will be paid, that he will receive an annual bonus, overtime pay, and free medical and hospital care.

While top salaries for sanitarians have been rising more rapidly since 1954 than for any other salary group, the median salary since 1952 has been $2,000 or more below that of engineers in local health departments and approximately $750 below the median salary paid to male professional and technical workers in the United States. Of the sanitarian positions studied, 7 percent were vacant, One-third of these, offering a starting salary of $4,479, were available to college graduates with no experience. Vacant positions for sanitarians offer higher salaries than filled ones. Among 675 filled positions with the same requirements, the median starting salary was $4,347.

Copies of the report may be obtained by writing to Walter A. Lyon, Philadelphia Department of Public Health, Room 630, City Hall Annex, Philadelphia 7, Pa.

Members of the reporting committee are: Walter A. Lyon, J. M. ASCE, chairman; William T. Ballard; Herbert J. Dunsmore, A.M. ASCE; Reinhart W. Koch, John W. Lemon, Eric W. Mood, Louis W. Pickles, Jack C. Rogers, and Lester A. Sanger.

FHA Seeks Data on Inverted Crown

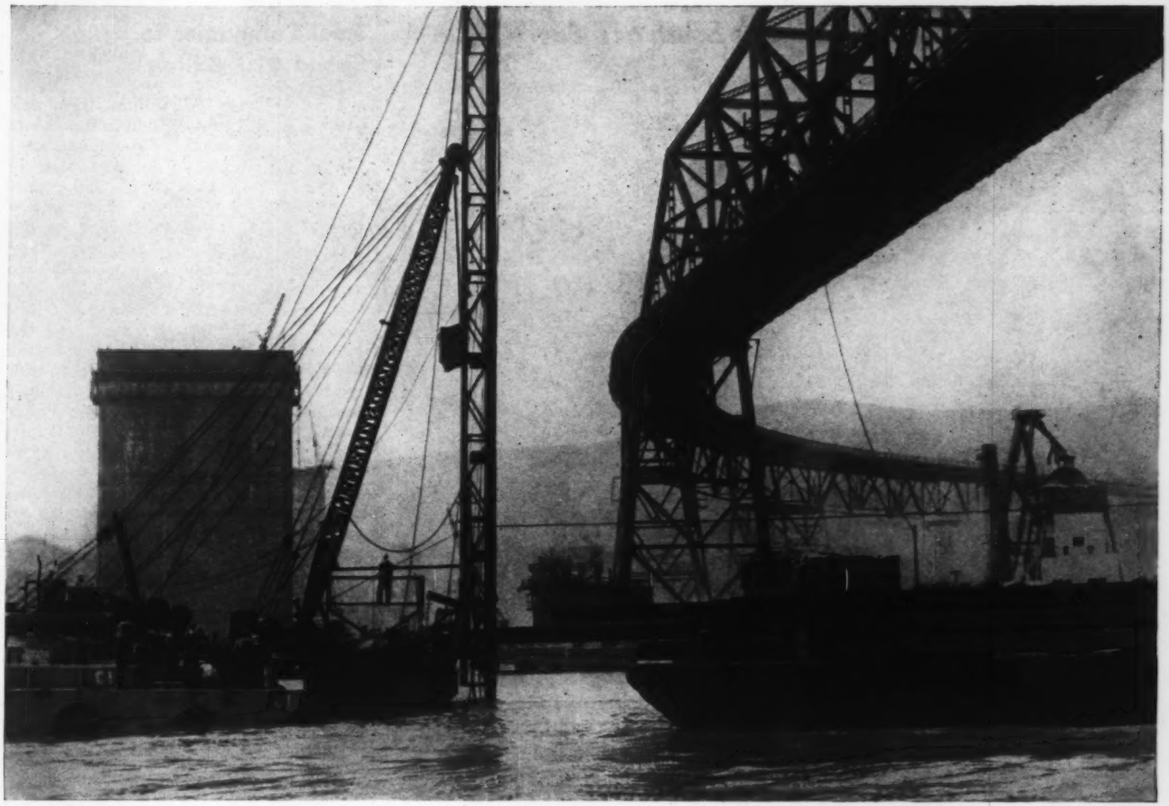
A study on inverted crown (street center drainage) design has been undertaken for the Federal Housing Administration by the Building Research Advisory Board. The study will include a survey and evaluation of experiences regarding the use of the inverted crown for light traffic residential streets and alleys in new subdivisions. Arterial streets and secondary roads are excluded from the study. The FHA expects that data provided by the study will be useful as a guide in establishing minimum standards and in backing up discussions with local authorities where existing standards are deemed excessive by the FHA.

The BRAB Special Advisory Committee consists of thirteen builders and contractors, engineering and planning consultants, materials manufacturers, public and private research engineers, and government highway officials. K. A. Stonex, assistant director of the Proving Ground Section of General Motors Corp., is chairman.

H. E. Foreman Resigns as Managing Director of AGC

For reasons of health H. E. Foreman has asked to be relieved of his duties as managing director of the Associated General Contractors of America on April 1. As managing director since 1940, Mr. Foreman has seen AGC grow from an organization of 2,500 member firms, with a headquarters staff of twenty-five, to an organization representing more than 6,700 member firms with a headquarters staff of fifty-six.

In recognition of his "long and faithful service in the management of the association" and in order to "make further use of his talents and experience," the executive committee of AGC has adopted a resolution naming him adviser to the association when his resignation as managing director becomes effective.



Piers for new Carquinez Straits span rise to the left; at right, the existing bridge. Barge derrick hoists Bethlehem H-piles, prior to driving to bedrock. *Substructure contractors:* Mason & Hanger, Silas Mason Co., and F. S. Rolandi, Jr., Inc.

Steel piling for bridge piers stands in 100 ft of water

Unraveling a major traffic bottleneck on California's U. S. Route 40 required the building of a new span over Carquinez Straits, an arm of San Francisco Bay. The existing bridge will carry southbound traffic; the new bridge will provide four lanes for northbound traffic.

Piers 4 and 5 of the new bridge were placed in cofferdams of Bethlehem Sheet Piling. Pier 5 was placed in comparatively shallow water on the Contra Costa County side. At pier 4, the base of the cofferdam rests on 261 Bethlehem H-piles, driven in deep water to bedrock. Six of these piles were spliced to 145-ft lengths and placed at the corners and the centers of the 113-ft sides.

The remaining three piers are constructed in open-dredged caissons, built by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation, Bethlehem's West Coast subsidiary, and towed to the site. In the placing of all substructure work for the Carquinez Straits span, the tricky nature and velocity of the tides had to be carefully studied, and depths as great as 100 ft taken into account.

Dewatered cofferdam of Bethlehem Sheet Piling section ZP38 is braced with steel to withstand exterior water pressure.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

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BETHLEHEM STEEL

BETHLEHEM STEEL

Belgian Congo Bridge Connects South and East Africa

Zofu Bridge—a single-track 2,510-ft railroad span dedicated a few months ago—is the longest in the Belgian Congo. Crossing the Lualaba (or Upper Congo) River, the project joins the two railroad networks of the Compagnie du Chemin de Fer du Bas-Congo au Katanga and of the Chemins de Fer du Congo Superieur and establishes the first direct connection between the Atlantic Coast and South and East Africa via Lake Tanganyika. The continuous-span steel structure includes two 42-ft lift spans. It was three years under construction and cost about $4,500,000. The engineers were the Societe des Batignolles, a French company. Engema, Grecico, Les Ateliers de Construction de Jambes-Namur were the contractors on the substructure, and Enghien-Saint Eloi on the superstructure.

Moles Present Annual Construction Awards

Presentation of the Moles annual awards for "outstanding achievement in construction" took place at the organization's annual dinner, held at the Waldorf-Astoria in New York on February 6. The winners—Guy F. Atkinson, M. ASCE, of San Francisco, and Louis R. Perini, of Framingham, Mass.—are the seventeenth pair honored in a series that started in 1941 and has included many notables in the heavy construction field.

Mr. Atkinson, the non-member winner, is board chairman of the Guy F. Atkinson Company, which has performed more than a hundred major contracts in this country and overseas, including Grand Coulee Dam, McNary Dam and Powerhouse, and the atomic energy plants at Hanford, Wash. Mr. Perini, the member winner, is president of B. Perini & Sons, a company prominently identified with many of the largest dam and tunnel jobs in the East in the past twenty years.

Honorary membership in the Moles was conferred on Jesse V. Honeycutt, featured speaker. Mr. Honeycutt is sales vice-president of the Bethlehem Steel Company and a director of the Bethlehem Steel Corporation, with which he has been associated for over 42 years.

Bertram Tallamy Takes New Federal Highway Post

Following confirmation by the Senate Public Works Committee, Bertram D. Tallamy, M. ASCE, was sworn in as Federal Highway Administrator on February 5. Mr. Tallamy received President Eisenhower's nomination to the new subcabinet administrative post in October (November issue, page 84), but was unable to take office at that time because of commitments as chairman and executive officer of the New York State Thruway Authority. John A. Volpe, former Massachusetts Commissioner of Public Works, has been interim administrator.

Mr. Tallamy said that one of the problems he is planning to study "in great detail" is that of billboards. In his new post he will have direct responsibility for the administration of the Bureau of Public Roads and the national highway program.

Steel Companies to Spend $1.7 Billion

After pouring $8 billion into new equipment and construction in the eleven postwar years, the nation's iron and steel companies indicate that they plan to spend a record $1.7 billion this year—an annual amount unmatched in the history of the industry, according to the American Iron and Steel Institute. The scheduled outlay will be 42 percent above the 1956 outlay of $1,200,000,000. The huge sum planned for capital expenditures is over six times the amount the industry was spending annually a decade ago. However, this will be the fifth recent year in which the outlay has reached or exceeded the billion-dollar mark.

The problem of finding funds for expansion and for financing the stay-even requirements in the iron and steel industry is a serious one, according to executives of the companies. Inflation has greatly increased construction and equipment costs. Because of the inadequate amounts recovered from depreciation, there has been a heavy drain on profits to replace obsolete facilities.

Currently the industry faces heavy demands for steel for shipbuilding, highway construction, freight cars, pipelines, and other facilities.

AED Studies Financing Equipment Problems

Some 3,500 representatives of United States and Canadian equipment distributors and manufacturers gathered at the Conrad Hilton Hotel in Chicago early in February for the 38th annual meeting of the Associated Equipment Distributors. With one of the outstanding sales years in the history of the industry ahead, discussions were many and heated. Primary attention was directed toward the financing of equipment sales. Frederick Salditt, vice-president of the Harnischfeger Corp., estimated that, "The construction equipment manufacturing and distributing industry as a whole will have to be prepared to do from $300 to 350 million more equipment manufacturing and sales financing than it has done during the year 1956, an increase of from 20 to 28 percent." Discussion also embraced the important subject of distributor-contractor relations.

In conjunction with the meeting, AED held its first equipment and materials show, Condex. Here 125 manufacturers and service organizations not represented at the Road Show displayed their wares to an eager market.

New AED president, elected during the meeting, is L. Miner Doolen, vice-president and treasurer of the Telford Equipment Company, Lansing, Mich.

Over 50% greater strength than
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HI-HED makes a perfect utility gallery. Pre-cast HI-HED units speed installation and cut construction costs.

Our technical staff will be pleased to assist you with your pipe problems.

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Deep cuts and high fills are often encountered in maintaining the minimum grades which are consistent with good highway design. In the past, drainage structures under high fills have proved delaying, cumbersome and costly. But now, American-Marietta offers you a practical solution—HI-HED Reinforced Concrete Pipe with *50% greater strength than its round pipe equivalent.*

When used as storm or sanitary sewers HI-HED permits greater self-cleansing velocities in dry weather periods. In urban areas HI-HED makes full use of available cross-room without disturbing existing utilities. Find out more about HI-HED, the stronger, versatile, elliptical pipe that's destined for an important role in the multi-billion dollar highway program. Write today.

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Large Drydocks to Be Constructed in Bahamas

Preliminary work is under way in the Bahamas on two large drydocks and repair shops. The new facilities will handle the giant oil tankers that are being built by the National Bulk Carriers of New York at the Kure shipyards in Japan. They will be located on Grand Bahama, a practically uninhabited island off the Florida coast in the Palm Beach area. In addition to building a town for its workers, the company will also construct a cement plant to provide material for the project. When the tanker-repair station is in operation about two years from now, it will be able to overhaul such giant tankers as the 85,000-ton Universe Leader, which National Bulk Carriers put into operation last year.

National Bulk Carriers is also planning two other major port installations in the Panama-Mexico area. One includes a deepwater dock, which will be built on a recently purchased 2,000-acre site in Las Minas Bay near the northern entrance of the Canal Zone and will enable ships to discharge cargo for Panama outside the Canal Zone. The other port operation will probably be on the Pacific Coast of Mexico below San Diego.

Protecting Concrete On Table Rock Dam

A new method of protecting large masses of concrete from rapid changes in temperature, which eliminates the use of expensive materials and speeds up the job, is currently being used on the Table Rock Dam project. Located on the White River, eight miles west of Branson, Mo., the $68,700,000 project incorporates 1,300,000 cu yd of concrete.

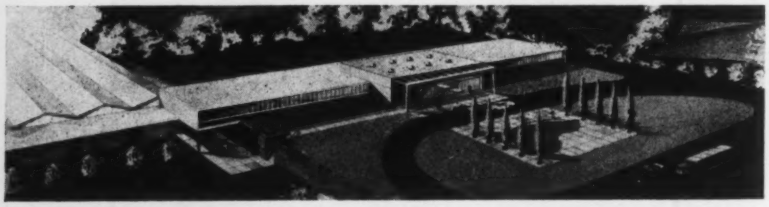
The concrete dam structure is made up of 30 individual monoliths. Concrete is placed in one monolith at a time in 7½-ft lifts and, in the partially completed structure, the monoliths differ in elevation. During the cold weather, the exposed surface of the bulkhead face of each monolith is subjected to quick changes in temperature that cause it to expand and contract quickly. This induces hairline cracking of the concrete, which in turn weakens the structure and creates possible sources of leakage.

A long and careful search for feasible insulations resulted in the choice of Styrofoam, a rigid plastic foam produced by the Dow Chemical Company. Long used as an insulating agent and as a water-vapor barrier in numerous other applications, light-weight Styrofoam was a natural for protecting concrete.

The Morrison-Knudsen Company and the Utah Construction Company, joint-venture contractors for the project, working in conjunction with the Army Corps of Engineers, came up with the novel application.

In this method Styrofoam planks 1 x 12 in. x 9 ft, are nailed to panels made of ½-in. plywood sheets spliced together. The panels vary in size from 4 x 7½ ft to 4 x 22½ ft, depending upon the height of the concrete face to be protected. These panels of Styrofoam and plywood are lapped, one over another, and held in place by vertical walers of two 2 x 6-in. boards. The vertical walers are blocked at the bottom with wedges driven against dowels drilled into the concrete of the adjacent monolith. The top is held in place by anchor-bolts previously set to support the steel forms. The vertical walers are spaced at 6-ft centers, and the entire surface of concrete is completely covered. Almost all of the material can be salvaged for reuse at a later date.

Packaged Prestressed Swimming Pools Are Built Here



Complete line of swimming pool equipment is being manufactured in this ultra-modern 400-ft-long plant opened by the National Pool Equipment Co. at Florence, Ala., on January 1. The line features a prestressed, precast concrete swimming pool package available to engineers and contractors in any required size from 16 by 32 ft on up. The prestressed pool is especially designed to withstand the unusual forces caused by heavy freezing in northern climates. A simplification of the prestressed pool package permits individuals or contractors to build the pool without previous experience in constructing swimming pools.

N*G*Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"I betcha 3 bucks I know the answer!"

"Who said that?" asked the Professor.

"Joe," tattled Cal Klater, "and I'll take him for 3 easy bucks."

"Sucker," gloated Joe Kerr. "Now listen! The question was not how to do it, but how much it would cost at $1 per weighing to classify 7 lots of concrete samples, if each lot had either 7 30-lb dry-cured or 7 31-lb wet-cured specimens. Right?"

"Right."

"Which couldn't cost over $7, weighed lot by lot, and surely less or the problem wouldn't make this column."

"Bright, so far."

"And which can't be done for $1 by the McTavish system of taking 1+2+4+8+16+32+64 from respective lots, these lots being smaller."

"Bracketing 5 guesses, 2 to 6."

"But the system can be used in two steps, say of 1+2+4 to classify 6 lots of 6 samples, or of 1+2+4+8 for 8 lots of 8, so you can see why Professor Neare picked on 7 lots of 7. Apparently the step system would handle 6 lots for $2 and the 7th for an extra buck."

"So your answer is the 3 bucks you bet?"

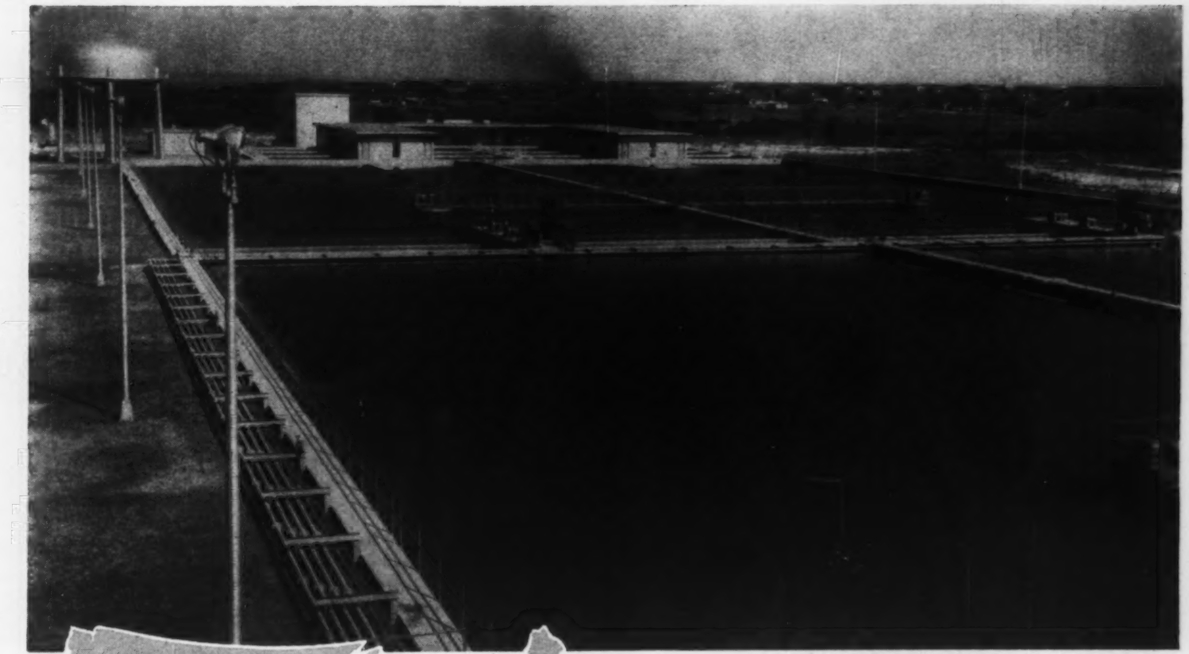
"Nope. With $3 too easy and $1 too impossible, the answer must be $2, which is what I bet $3 on for a bluff. Pay me, sucker!"

"Why you bumptious rascal, cashing in on your ignorance. All you had to do was make your second step the combination 3+5+6+7."

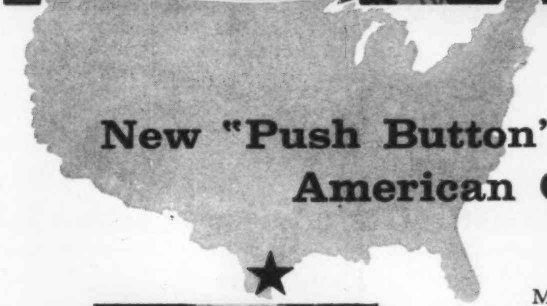
"That's right," exclaimed the Professor. "Joe takes the pot, but Cal takes the cake. The combination 3, 5, 6, 7 makes 16 of the numbers from 0 to 21 without duplication. Hence, for example, if the excess weights were 6 on the first weighing and 12 on the second, they would have to be 2+4 and 5+7, identifying as wet-cured the lots from which 2, 4, 5 and 7 samples had been selected, and the other three lots as dry-cured. Do you want an easier sequel, Joe?"

"No, thanks. This was easy—for 3 bucks."

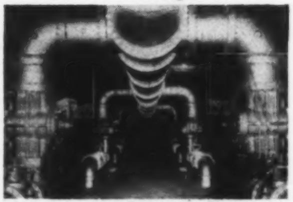
"Then let's speculate about the weather, and particularly about the drought. Joe Doakes, who has had a farm in the dust bowl for 37 years, says the drought is the worst since the seven lean years of biblical times. If we suppose wet and dry years are equally probable, how often in a 37-year record will there be 7 or more dry years in succession?"



New O. N. Stevens Filtration Plant at Corpus Christi, Texas



New "Push Button" Filtration Plant Uses American Cast Iron Pipe



One of 2 pipe galleries under filter control building, with 42" wash water manifold overhead. American Cast Iron Pipe and Fittings.

Filter Plant Effluent. Six high service pumps connect to 48" discharge manifold. American Cast Iron Pipe and Fittings.

Many of the operations at Corpus Christi's new water filtration plant are controlled from a central panel in its modern, functional filter building. Much of the "push-button" control equipment is new to the water works field.

When it came to pipe, designers of this new plant chose a long-time favorite of water works men — American Cast Iron Pipe. Time-proved, durable American Cast Iron Pipe adds not only the assurance of long, trouble-free service life, but also the economy and efficiency required by modern plant design and operation.

Call your American Cast Iron Pipe Company representative when your new plant or system is in the planning stage. Experienced, capable and cooperative, he can help you effect maximum economies in initial and maintenance costs.

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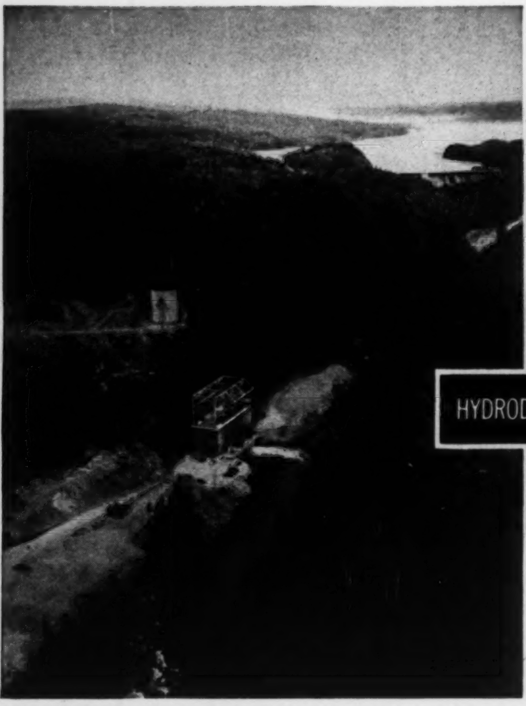
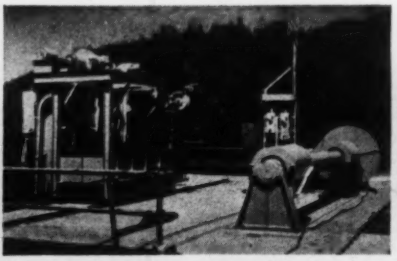
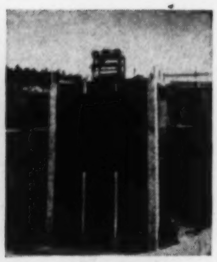


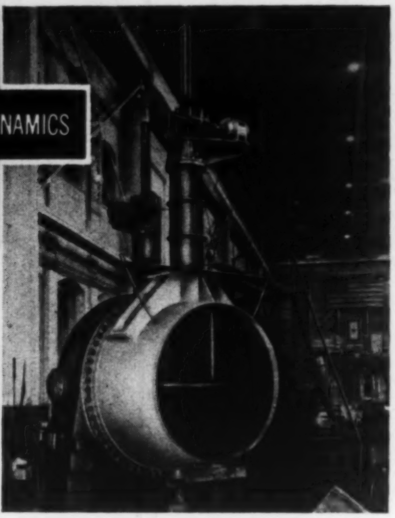
A 16-foot diameter tunnel leads from Ripogenus Dam to the surge tank, from which two penstocks feed the McKay Station turbines. Each turbine has a plate steel spiral case, shop welded in two halves with riveted butt strap connections. SMS accessory equipment is installed at the dam and in the station. Consulting Engineers: Stone and Webster Engineering Corp.





SMS intake gate is installed at the left end of the dam. The 10-foot trash rack rake and self-contained trash car are shown (above) in lowering position above the center rack. Upper left photo shows rear view of the hoist support and trash car, with the 60,000 lb. intake gate hoist in the foreground.

HYDRODYNAMICS



Motor-operated Dow valves, installed at the inlet of each spiral case, provide tight shut-off. Note the streamlined valve disc and housing around operating link connection to the disc.

SMS TURBINES POWER RIPOGENUS EXPANSION

On the upper Penobscot River, Ripogenus Dam had been a storage reservoir for Great Northern Paper Company's downstream power plants since 1916. When studies made in 1950 indicated more power was needed, McKay Station was built. A 4,000-foot, rock-lined tunnel, leading from a new intake in the dam face to the power house below, created a net effective head of 175 feet. Two vertical SMS-Francis turbines, rated at 16,590 hp, were installed, and provision made for the ultimate addition of another unit.

SMS hydraulic equipment was chosen for the entire project. The 18 x 20-foot fixed wheel turbine intake gate is operated by a twin-drum, motor-driven chain hoist. A special log-grapple type trash rack rake keeps the intake free of pulp wood and other debris. Two 108-inch SMS-Dow valves provide shut-off at the turbine inlets.

This Ripogenus hydroelectric expansion typifies S. Morgan Smith's ability to satisfy the complete needs of any project. Over 75 years of world-wide experience in design and manufacture of hydraulic turbines and accessories assures you of equipment that will meet the highest standards. For full information, write S. Morgan Smith Company, York, Pennsylvania.

SMS

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
ACCESSORIES

HYDRODYNAMICS

ROTOVALVES
BALL VALVES
BUTTERFLY VALVES
FREE-DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

AMERICAN BRIDGE builds new Cleveland Bridge for B&O

This new B & O Railroad bridge, recently installed over the Cuyahoga River, in Cleveland, replaces the original bridge built in 1911. Designed by Hardesty & Hanover, Consulting Engineers, New York, N. Y., the bridge consists of one single-track, single-leaf heel trunnion thru-truss bascule span, 255 feet long; one single-track thru-truss tower span for the West approach, 55 feet long; and one single-track deck plate girder span for the East approach, 63 feet long.

All steelwork for this structure was fabricated and erected by the American Bridge Division. 1,796 tons of structural steel, 166 tons of castings and 13 tons of reinforcing steel were used.

Under the terms of the contract, the responsibility of the American Bridge Division included the operator's house, machinery house, operating machinery, counterweight boxes and trusses, counterweight concrete, electrical equipment for bascule span operation, engine-generator for emergency span operation and lighting, main trunnions and bearings, counterweight trunnions and bearings, platforms, walkways and stairs, installation only of railway deck, temporary timber stringer span at east abutment, and removal of existing bridge superstructure. All in all, a large and important job, and another proof of the ability of the American Bridge Division to handle successfully and efficiently all types of bridge installation.

If you would like to know more about the bridge-building facilities of the American Bridge Division, just get in touch with our nearest office. We'll be glad to discuss your bridge requirements with you.

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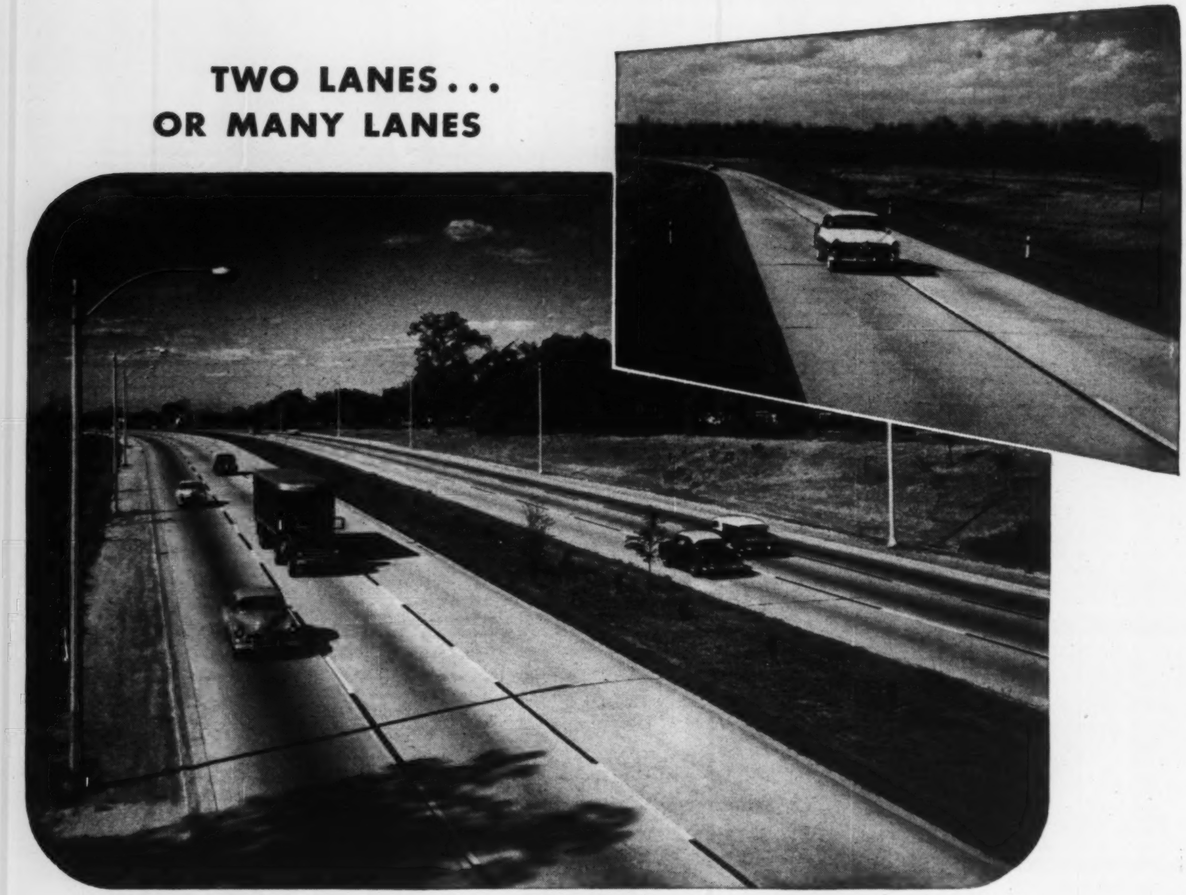

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New Forming Technique Produces Sawed Joints At Less Cost

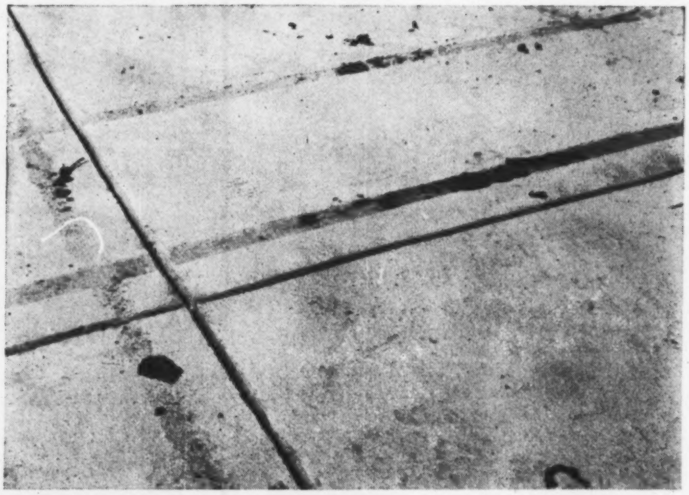


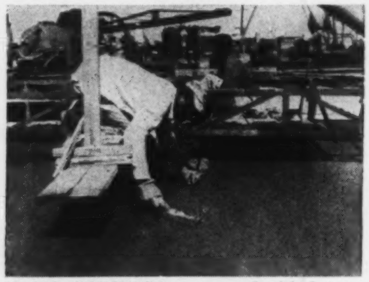
FIGURE 1

. . . uses KORK-PAK® as dummy joint filler; removes filler after concrete cure by sawing

An interesting new joint forming and sawing technique, in which lengths of KORK-PAK®—a non-extruding expansion joint filler, are used as a dummy joint filler and then sawed out by an inexpensive ⅜" carborundum blade after the concrete has cured, has been developed and used with good results by T. L. James Construction Company on a Mississippi State Highway Project. Location of the Project was on Route 51, south of Jackson, Miss.

Clean, straight ¼" joints (Fig. 1) are produced at a fraction of the cost of sawing ⅛" joints in the ordinary manner with a diamond blade. Joint sawing speed was considerably increased, and the resulting ¼" wide joint was sealed with "Zero-Lastic."® a single component, cold-applied joint sealing compound manufactured by Servicised Products Corporation, Chicago, who also produce the KORK-PAK material used on the project.

KORK-PAK DUMMY JOINT is embedded in concrete. *Figure 2*



HAND FINISHING over embedded joint produces smooth surface. *Figure 3*

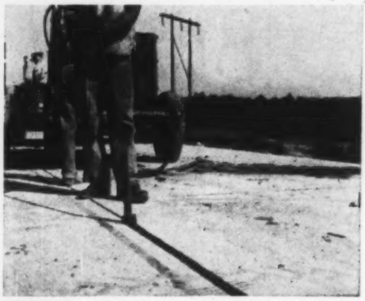
KORK-PAK is a composition of asphalt and granulated cork, formed between two sheets of asphalt saturated paper. It is non-extruding and is readily handled without breakage. It is a general purpose joint filler widely used on highway and turnpike projects. The KORK-PAK material was easily sawed out and did not gum up the blade, as did other types of asphalt and hard-board joints.

Essentially, the new technique consists of embedding ¼" wide x 2" high lengths of the KORK-PAK in transverse and longitudinal joints at the time the concrete is being placed (Fig. 2). Transverse joints were spaced at 31'4" intervals. The small surface sections of concrete disturbed by insertion of the joint were finished by hand. (Fig. 3).

After the concrete cured, a saw, equipped with a ⅜" carborundum blade quickly and easily removed the top inch of the KORK-PAK (Fig. 4) leaving the other inch undisturbed in the concrete. When desired, the blade can be set to remove all of the dummy joint and seals up to 2" or deeper can be obtained.

AFTER CONCRETE CURES, top 1" of dummy joint is sawed out. *Figure 4*

Using the KORK-PAK dummy joint technique, the contractor reported getting from 2500 to 3000 lineal feet per blade. The ¼" joint obtained was practical to seal and gave the pavement the same riding qualities as one in which the joints were sawed by a diamond blade in the conventional manner.



SEALING JOINT — "Zero-Lastic" Cold-applied material is pumped into joints from container. *Figure 5*

After cleaning the sawed joints, the contractor applied Servicised "Zero-Lastic" Joint Sealing compound (Fig. 5) in the usual manner.

More information and specific details on the material and equipment used on this project are available from Servicised Products Corporation. Write for the Servicised Catalog which contains valuable data and complete details on Servicised Asphalt, Cork and Rubber composition products for the construction industry.

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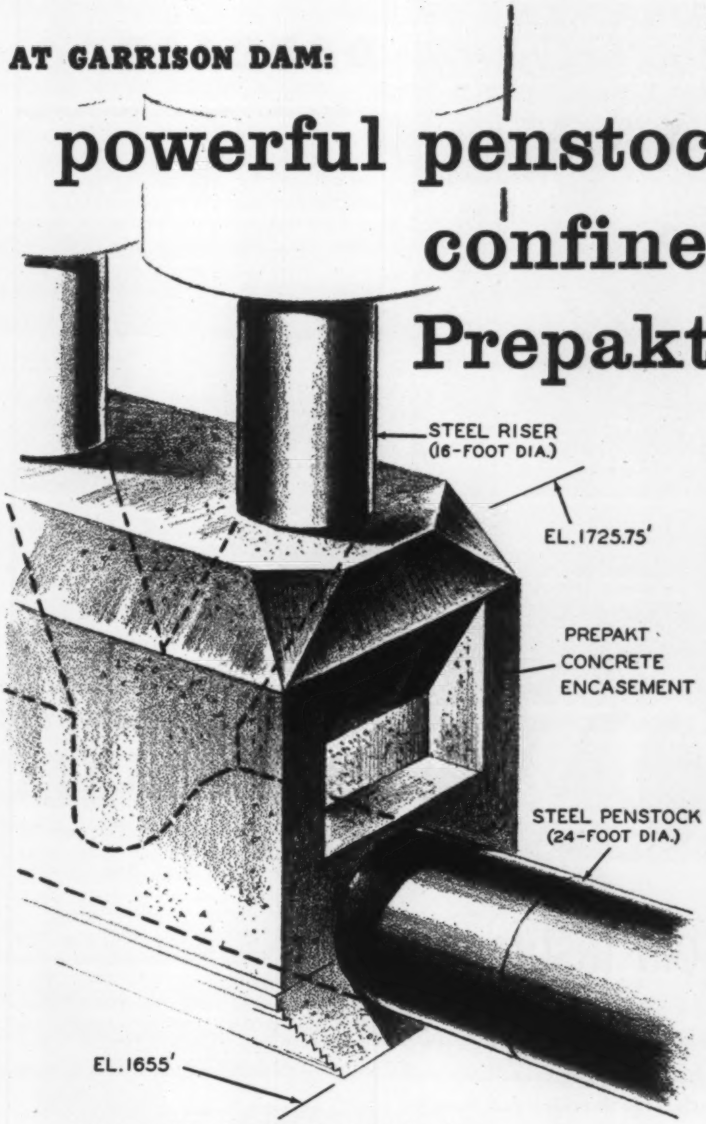
STEEL RISER (16-FOOT DIA.)
EL. 1725.75'
PREPAKT CONCRETE ENCASEMENT
STEEL PENSTOCK (24-FOOT DIA.)
EL. 1655'

Diagram of Garrison Dam riser connection shows how 2,700 cu. yds. of PREPAKT concrete were used to encase it and tie two branches together.

Gigantic dimensions of riser and indeterminate stresses required heavy reinforcement and strong, low-shrinkage concrete.

Despite this dense reinforcement with heavy bars, PREPAKT methods and materials made possible the placement of high-quality concrete.

High-strength PREPAKT concrete now provides complete, monolithic encasements for three penstock riser connections at the 400,000 kw. Garrison Dam power plant on the upper Missouri River.

This concrete embedment is a strong supporting structure for the steel liner and helps take the high, fluctuating hydrostatic loads in the critical stress areas between penstocks and surge tanks.

PREPAKT concrete, made "in the form" by consolidating preplaced coarse aggregate with INTRUSION mortar, was used to (1) assure thorough embedment even under invert and at crown, (2) produce a permanent, tight bond between steel liner and concrete and (3) permit simplified but thorough placement in a very heavily reinforced area where conventional methods would have been difficult.

This is another successful project completed by INTRUSION-PREPAKT—specialists in concrete construction and maintenance who maintain a complete field construction organization and provide an engineering service. INTRUSION-PREPAKT, Inc., Room 568-C, Union Commerce Building, Cleveland 14, Ohio. In Canada: INTRUSION-PREPAKT, Ltd., 159 Bay St., Toronto, Ontario.

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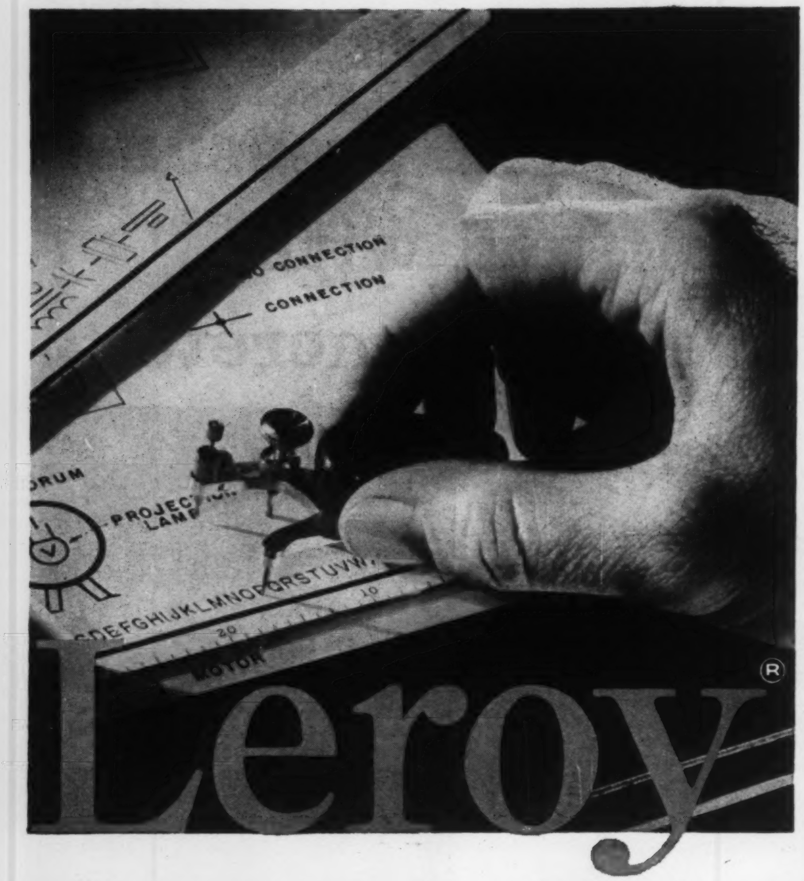
Intrusion and Prepakt are trade marks of Intrusion-Prepakt, Inc., whose methods and materials are covered by U. S. Patents Nos. 2313110, 2655004, 2434302 and others, also patents pending.



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DECEASED

Irvin H. Althouse (M. '30), age 69, partner in the Althouse-Strauss Engineering Services, Porterville, Calif., died at his home there on January 8. In 48 years of public service Mr. Althouse made important contributions to statewide programs for water development and conservation. From 1929 to 1931 he served as consultant to the state on San Joaquin Valley water problems, and worked with both federal and state officials and committees in developing plans that culminated in the Central Valley Project and the Friant-Kern Canal unit of that project. He served for many years as city engineer for Porterville, chairman of the City Planning Commission, and chairman of the Tulare County Water Commission.

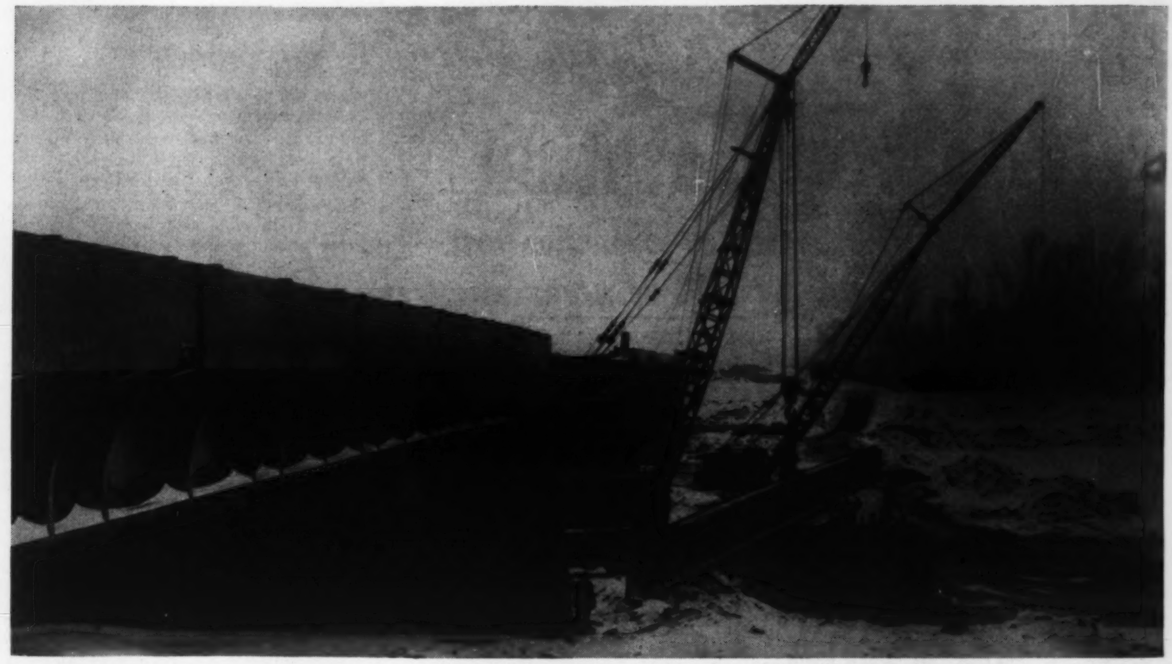
Edward F. Atwood (M. '16), age 90, retired construction engineer of Groton, Mass., died at his home there recently. Mr. Atwood worked on the design and supervised construction of reinforced concrete mercantile buildings from 1905 until his retirement in 1931. From 1916 on he was also construction engineer for the Scully Co. of Cambridge, Mass.

Astolfo Bartoccini (M. '19), age 83, retired civil engineer of Chappaqua, N. Y., died at his home there recently. Mr. Bartoccini, a native of Italy, was a graduate of the C. E. Royal School of Engineering in 1899. From 1909 to 1915 he was chief electrical engineer and construction engineer for the New York Edison Co., and from 1915 to 1920 engineer and general superintendent of the Andrew J. Robinson Co., of New York. From the latter year until his retirement in 1946 he was in private practice as a construction engineer in New York City and New Rochelle, N. Y.

Robert Lowton Bowen (A.M. '17), age 77, construction engineer of Providence, R. I., died recently at his home in Johnston, R. I. A 1902 graduate of Brown University, Mr. Bowen received his civil engineering degree in 1904. In his early career he was with Westinghouse, Church, Kerr, & Co., of New York City for five years on construction of the Pennsylvania Station there. From 1911 to 1918 he was resident engineer for the Rhode Island State Harbor Improvement Commission in charge of design and construction of state docks in Providence and Pawtucket. In private practice since 1925, Mr. Bowen worked on buildings for Brown University and numerous Providence structures.

John F. Covert (M. '46), age 75, retired civil engineer of El Cajon, Calif., died in San Diego recently. Mr. Covert had practiced engineering since 1904, and his

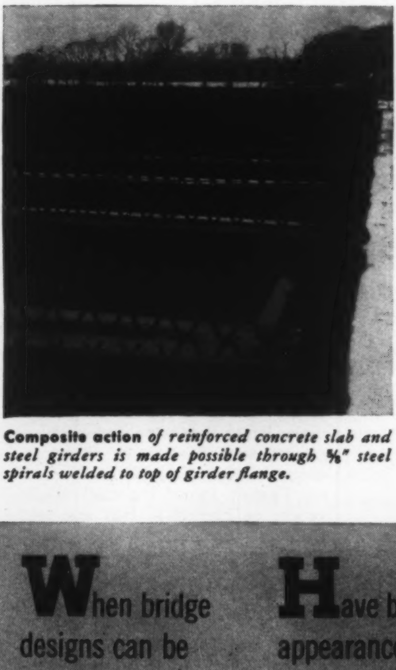
(Continued on page 112)



One of the largest all welded highway bridges *in the East. New York States' Erie Thruway over Cattaraugus Creek. Carries six traffic lanes, has center mall and safety walks on both sides.*

ALL-WELDED HIGHWAY BRIDGE DESIGNS

. . . take less steel, built for lower cost



Composite action *of reinforced concrete slab and steel girders is made possible through ⅝" steel spirals welded to top of girder flange.*

SUBSTANTIAL savings in steel and cost are being realized by the use of welded design in the construction of highway bridges by State Departments throughout the country.

This structure which carries the New York State Thruway across Cattaraugus Creek is composed of five 132 foot spans. The 8-inch reinforced concrete roadway slab is attached to the steel girders to provide composite action between structural materials of different characteristics. The slab is tied to the top flanges with 6-inch spirals of ⅝-inch steel welded to the girder flanges to take horizontal shear.

This bridge is one of hundreds of welded structures designed and built by the Department of Public Works of New York State. Savings average 15% to 20% in steel and construction over similar steel riveted structures.

Structural Engineers send for Studies in Structural Arc Welding giving data on welded bridge design. Write

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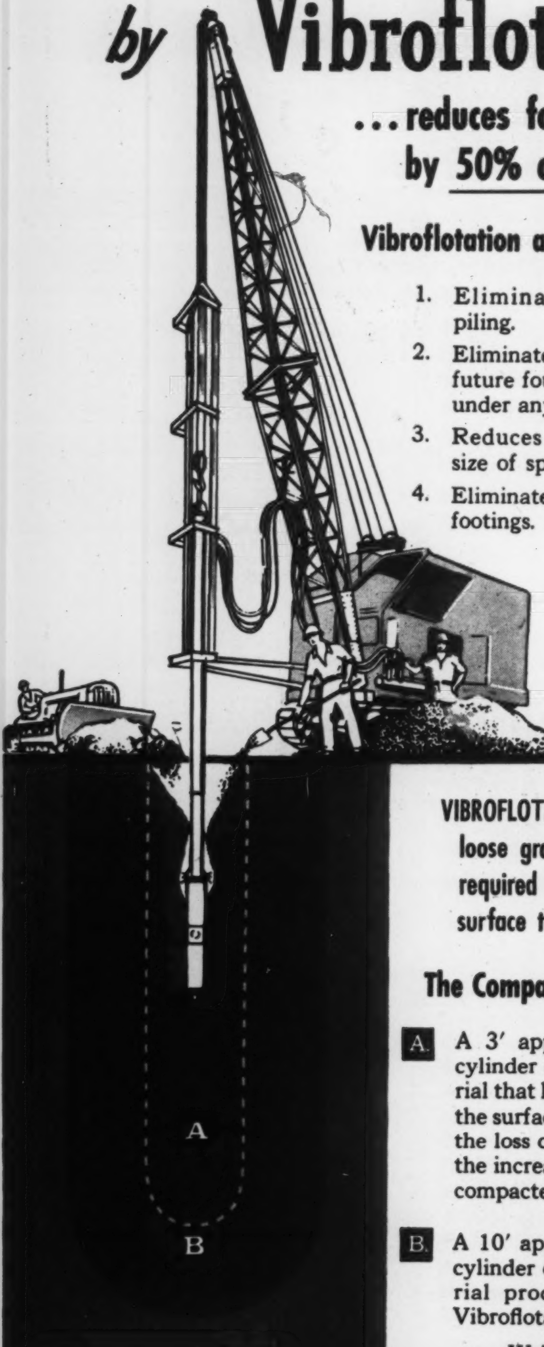


Deceased

(Continued from page 110)

experience included work for the cities of Santa Monica, Oceanside and San Diego. He had also been with various water companies, including ten years with the Sweetwater Water Corp. at National City, Calif., working on the Sweetwater Dam. He also worked for the State of California.

Francis T. Cutts (M. '25), age 76, retired consulting engineer and a former assistant water commissioner of St. Louis, died at his home there on December 12. Mr. Cutts graduated from Washington University in 1902. From 1904 to 1925 he was with the St. Louis Water Department as assistant engineer, engineer in charge, and assistant water commissioner. Mr. Cutts formed the Missouri Engineering and Contracting Company in St. Louis in 1925 and, after its dissolution in 1942, served as consulting engineer to various government agencies. He retired in 1948.

Carleton E. Davis (M. '08), age 87, vice-president and a director of the Philadelphia Suburban Water Co., of Bryn Mawr, Pa., died at his home in Merion, Pa., on January 29. A graduate of Massachusetts Institute of Technology in 1893, Mr. Davis served as resident engineer for the Newark, N. J., Water Supply for three years and engineer for the Isthmian Canal Commission for two years. Later he was department engineer for the New York Board of Water Supply and manager of the Indianapolis Water Co. He was chief of the Philadelphia Bureau of Water from 1913 to 1923, and in 1925 became connected with the Philadelphia Suburban Water Co.

William W. Fineren (M. '33), age 77, retired professor of engineering at the University of Florida, died at his home in Jacksonville, Fla., on January 1. He was a 1902 Cornell University graduate, with a mechanical engineering degree and special diploma in military proficiency. From 1903 to 1927 he was with the U. S. Engineer Department, working in New York, New Jersey, North Carolina and Florida. His accomplishments included the design and construction of timber-concrete breakwaters in Lake Ontario harbors, location of previously unknown sunken islands in the St. Lawrence River that were endangering navigation, and location of the locks and dams on Cape Fear River, N. C. Professor Fineren joined the staff of the University of Florida in 1927 and retired in 1945.

Edgar A. Goetz (M. '38), age 75, retired chief structural engineer for the St. Paul Foundry Co. of St. Paul, Minn., died at his home there recently. He was a graduate of the University of Wisconsin, class of 1904. Mr. Goetz was with the

(Continued on page 114)

The Surveyor's Notebook

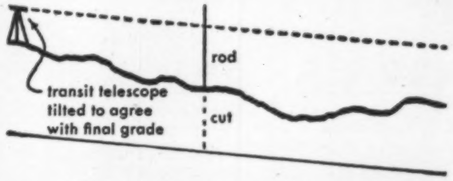
Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

FROM THE GURLEY MAILBAG:

A few tips on better instrument operation

—suggested by readers of "The Surveyor's Notebook"



On a light grade, the telescope on the level can be tilted to set such a grade, by using your leveling screws. *(This tip, illustrated above, has been sent in more frequently than any other to "The Surveyor's Notebook.")*

*

A hand level is very useful for checking instrument set-up elevation, particularly on steep grades.

*

When leveling, it is a good idea to have a pair of leveling screws oriented in the direction of the run. Any slight re-leveling can then be done with only one pair of leveling screws.

*

In making a sidehill set-up, the bottom plate can be kept nearly level by placing two legs downhill and one uphill. As a further suggestion, some engineers add one extension leg to their stiff-legged tripod to ease adjustment.

*

To be certain that all backlash has been taken out of upper or lower tangent and spring, lightly tap the edge of the plate with the index finger when making a setting.

*

Since the telescope level is usually about three times as sensitive as the plate level, it is suggested that the telescope level be used for accurate leveling of the transit.

A freshly chalked string appears to "shine" when sighted under conditions of hazy lighting, and is said to be more easily seen through a telescope than is a new white line. It is a good trick for use in heavy woods, on long sights against clothes of neutral hues or under other difficult conditions. Chalk can be given to each man carrying a plumb bob, with instructions to chalk the plumb line each morning.

*

It is suggested that the telescope be used in the inverted position frequently to avoid uneven axle bearing wear.

* * *

"Tips from The Surveyor's Notebook": *We have collected the most helpful, most discussed pages from Series One and Two of "The Surveyor's Notebook" in one 20-page book. These valuable field suggestions will help you use your own instruments with greater success. Write for your free copy.*

TIPS—SURVEYOR'S NOTEBOOK

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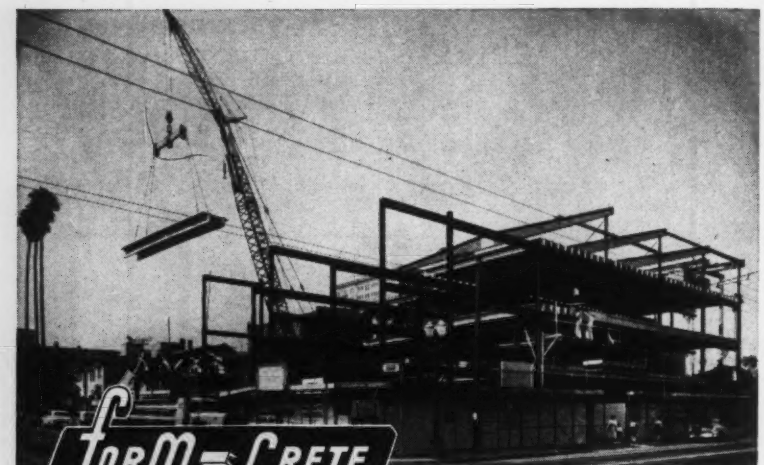
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Deceased

(Continued from page 112)

St. Paul Foundry Co. from 1906 on, serving as chief structural engineer from 1911 until his retirement in 1949. He was active in the Northwestern Section and served as president in 1949.

Nathan C. Grover (M. '14), age 88, chief hydraulic engineer for the U. S. Geological Survey from 1913 until his retirement in 1939, died at his home in Washington, D. C., recently. He was an 1890 graduate of the University of Maine, receiving his civil engineering degree there in 1897 and an honorary doctorate from the same university in 1930. After serving as an engineering professor at the University of Maine, Mr. Grover first joined the Geological Survey in 1903. From 1907 to 1911 he worked as a hydraulic construction and irrigation engineer for the J. G. White Co. in New York, returning to the Survey as chief engineer of its Land Classification Board. Mr. Grover was author of the book *River Discharge*, and numerous government texts on techniques of stream gauging.

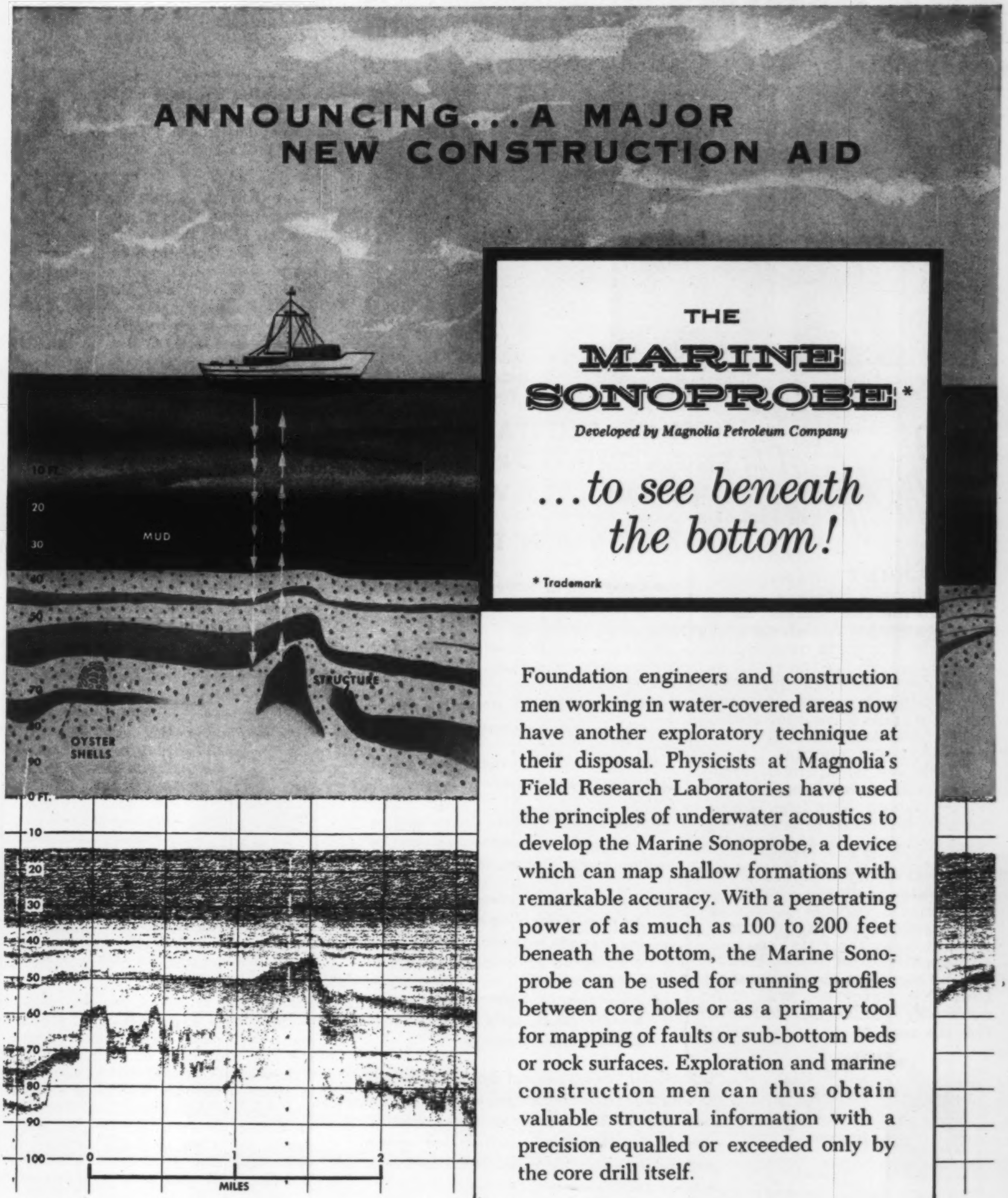
Donald M. Hatch (M. '27), age 62, since 1947 district engineer for the Community Facilities Service of the Housing & Home Finance Agency in Detroit, Mich., died at his home in Wyandotte, Mich., recently. He was a graduate of the University of Michigan College of Engineering, class of 1918. From 1920 to 1935 Mr. Hatch was superintendent of the Department of Municipal Service for Wyandotte; superintendent of the Department of Water Supply for Jackson; superintendent of construction for the Michigan State Building Department; and supervising engineer for the Detroit Water Board. He practiced as an attorney and counsellor at law in Wyandotte from 1936 until 1940 when he became Michigan state engineer of Public War Works for the Federal Works Agency.

Clifford M. Hathaway (M. '21), age 72, former state highway engineer of Illinois and a veteran employee of the Illinois State Highway Division, Springfield, died in a hospital there recently. Entering the service of the state in 1912, Mr. Hathaway was engineer of construction from 1922 until 1949, when he was appointed chief highway engineer. He resigned because of ill health in 1951, but continued as a consultant to the Highway Division until February 1954.

Herbert S. Kimball (M. '10), age 87, died recently at his home at Redondo Beach, Calif. Mr. Kimball graduated from Massachusetts Institute of Technology in 1891, and shortly afterwards established an office in Boston for the practice of mill architecture and chemical engineering. He conducted this busi-

(Continued on page 116)

ANNOUNCING...A MAJOR
NEW CONSTRUCTION AID



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W. R. MEADOWS, INC.

20 KIMBALL STREET
ELGIN, ILLINOIS

Deceased

(Continued from page 114)

ness for forty years, retiring in 1931. Mr. Kimball was a veteran of World War I, serving as a captain in the Nitrate Division of the Ordnance Department stationed in Washington.

Day Okes (A. M. '13), age 73, retired partner of the Okes Construction Co., St. Paul, Minn., died at his home there recently. Mr. Okes had been in construction work since 1908, when he graduated from the University of Minnesota College of Engineering. The present Okes firm, a successor to the Hanlon & Okes Co., was formed in 1933 on a partnership basis with Mr. Okes brother, Sidney R. The firm's work included highway and heavy construction projects in Panama and the Alcan Highway. Mr. Okes was a veteran of World War I, serving as a major in the Corps of Engineers.

C. G. Richardson

Charles G. Richardson (M. '21), age 78, retired vice-president of Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R. I., died at his home in Rumford, R. I., on February 3. Prominent in the water and sewage industry, Mr. Richardson retired in 1955 after 52 years of service to his company and the industry. He was a 1900 graduate of Brown University with a mechanical engineering degree. Mr. Richardson spent three years with the Brown & Sharpe Manufacturing Co., before joining Builders Iron Foundry as assistant chief engineer. In 1935 he became a sales engineer, later manager of sales, and in 1944 vice-president of Builders-Providence. Mr. Richardson held several patents in the field of metering and controlling and was the author of many technical and historical articles.

Lloyd Otto Zapp (M. '53), age 43, senior supervising civil engineer in the Houston, Tex., office of the Humble Oil & Refining Company, died at his home in Houston recently. Following graduation from the Agricultural and Mechanical College of Texas in 1934, Mr. Zapp started his career of nearly twenty-two years with the Humble Oil Refining Company of Texas. In 1948 he was promoted to senior supervising civil engineer, assisting in handling all construction work for the production department throughout the Company operations. Mr. Zapp's service with Humble was interrupted twice, first to serve in World War II in the Army Corps of Engineers, and during the Korean conflict he was loaned by Humble to the Petroleum Administration for Defense in Washington, D. C., as chief of the Construction Branch, Materials Division.

No "Cure-All," but...

Salinas, California, finds a single grade of Bitumuls® solves five paving maintenance problems

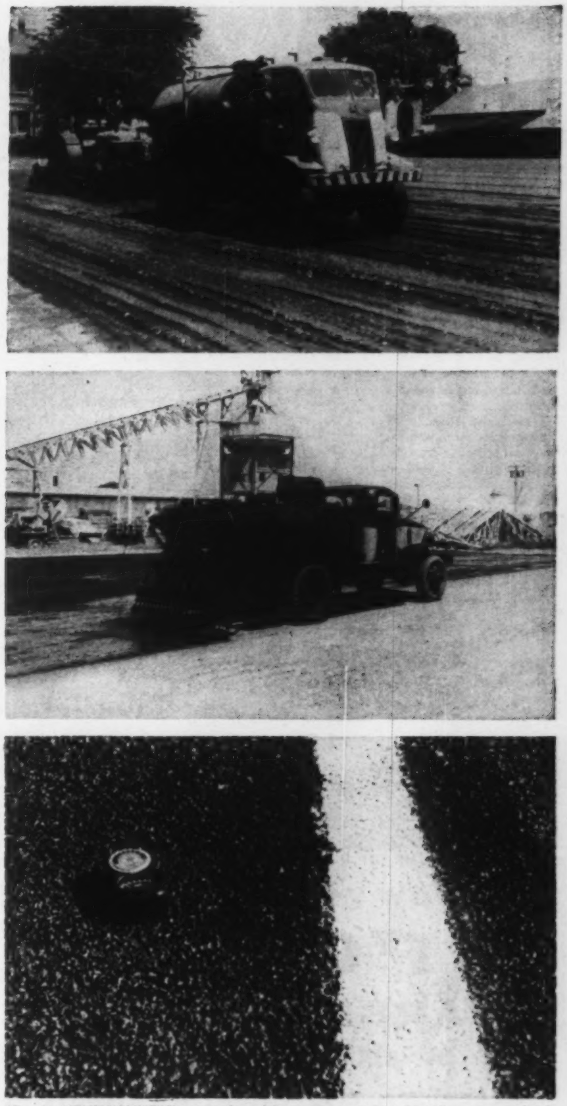
HERE'S A SITUATION common to most growing cities: annexation of outlying residential developments has vastly expanded the street maintenance job *without* materially increasing available funds. Annexation has not only added to the street mileage, but has "contributed" many sub-standard pavements to the street system, thus adding to the complexity of the job.

In an effort to solve this problem, these three Salinas men most directly concerned have worked together: Thomas A. Dunne, Director of Public Service; his assistant, Al Rossi; and Harry Adams, Maintenance Supt. Their search for simplicity and standardization led them to look for a versatile asphalt material that would do many jobs. They found it in Bitumuls SS-1, an asphalt emulsion that can be handled and used without heating, in small quantities or large.

Now, stored in a single 25,000-gallon tank, Bitumuls SS-1 is used for: Patching, Tack Coats, Prime, Seal Coats & Surface Treatments, and for Base Stabilization. In addition, Salinas City Forces can also use this same grade of Bitumuls for the new Slurry Sealing; and—at high dilution—for dust-laying on unpaved, outlying roads. All of these jobs can be done with existing equipment: a grader, a "Pulvimixer", a water wagon, two distributors, and a roller.

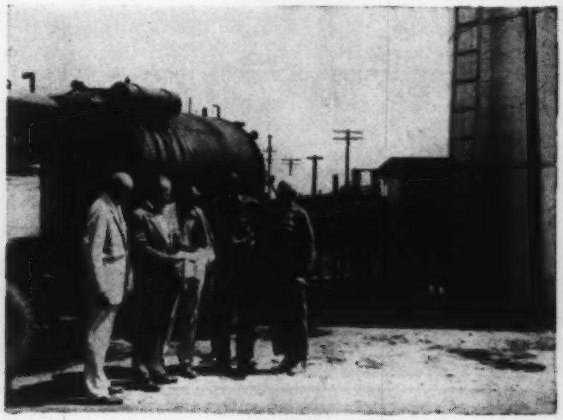
The obvious economies resulting from the use of this one material for all these jobs merit investigation by paving maintenance men everywhere, regardless of the size of their community.

There's a Bitumuls man near you who can supply details. *Call him, today, or write:* **American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.**



(Top), "PULVIMIXER" reworks old pavement that has been scarified and bladed in restabilization operation. Distributor applies Bitumuls at ¾ gal./sq. yd. per inch of depth. **(Center), DISTRIBUTOR** applies prime on a waterbound base, using Bitumuls SS-1 diluted (2 parts SS-1 to 1 part water) at 0.3 gal./sq. yd. of dilution. **(Bottom), HERE'S A CLOSE-UP** of the finished texture of a Bitumuls SS-1 Seal Coat pavement.

(Right), SALES ENGINEER Bob Ridell, far left, of American Bitumuls & Asphalt Co., discusses plans with Tom Dunne, Director of Public Service for Salinas, and his assistants. At far right is a partial view of the 25,000 gal. storage tank. **(Below), EVEN SCHOOL YARDS** are given stabilized bases with Bitumuls SS-1.



RECENT BOOKS

(Added to the Engineering Societies Library)

American Power Conference Proceedings, Vol. XVIII, 1956

The present volume of this annual publication features a nuclear energy forum at which some of the broader aspects of nuclear power development were considered: the role of industry and of government, research tasks, etc. The papers delivered at the regular sessions—mechanical, electrical, nuclear energy, and water technology—are devoted to a wide range of subjects, including supercharged boiler design, fly ash and slag, air pollution, high-temperature, high pressure power generation, 300-3,000-cycle power in industry, digital computers for power system analysis, and ion-exchange membranes for water conditioning. Various aspects of corrosion are treated in a group of five papers delivered at a special symposium. (Illinois Institute of Technology, Technology Center, Chicago 16, Ill. 665pp., $8.00.)

American Wood-Preservers' Association Manual of Recommended Practice

Revised Edition, 1956.

A practical manual of standards for those concerned with the processing of lumber or its use in construction. The publication is divided into six sections: (1) The index; (2) preservatives; (3) treated products; (4) analysis methods; (5) miscellaneous instructions and tests; and (6) conversion factors and correction tables. (Published by the Association, 839 Seventeenth Street, N.W., Washington, D.C. Various pagings. Price not given.)

Elasticity, Fracture and Flow; with Engineering and Geological Applications

This is a concise exposition, for engineers and geologists, of the basic mathematics of the theories of elasticity, plasticity, viscosity, and rheology. The book is comprised of three chapters devoted to the detailed analysis of stress and strain; the behavior of materials (including criteria for fracture and yield); and the equations of motion and equilibrium. (By J. C. Jaeger. 1956, John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 152pp., $2.50.)

Engineering Structural Failures

The author, Rolt Hammond, has surveyed the causes and results of engineering failure, for over a century, in various types of structures including earthworks, dams, sea walls, wharves, buildings, bridges, and tunnels. Vibration problems in foundations, earthquake effects, and cracking in welded steel structures are also considered. The last chapter deals with the lessons of failure and various modern methods of testing materials, such as the strain gage, scale models, the de Havilland moving-coil vibrator, and X-rays. Among the famous cases of failure discussed are the Quebec and Tacoma Narrows bridges and the Sydney water-pressure tunnel. (1956, Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. 224pp., $12.00.)

Engineering Uses of Rubber

A text and reference work for engineers outside the rubber indusrty who use rubber for applications in other fields. Consisting of sixteen chapters by eighteen rubber technologists, the book includes uses in electrical, civil, and chemical engineering. Also treated are the design of mountings, tires, belt conveyors, rubber in automobiles, and rubber in aviation. The book concludes with a brief discussion of the molecular structure and mechanical properties of rubber. (Edited by A. T. McPherson and A. Klemin. 1956, Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N.Y. 490pp., $12.50.)

Die Korrosion des Eisens und Ihre Verhutung

A monograph on the corrosion of iron and steel and its prevention, for the metal-working industry and the industrial user. The book covers basic theory, properties of iron and steel, corrosion as an engineering problem, corrosion testing, selection of materials to avoid corrosion, inhilitors and cathodic protection, protective coatings, and other surface treatments. A bibliography of over 1,300 references is appended. (By H. Klas and H. Steinrath. 1956, Verlag Stahleisen, Düsseldorf, Germany. 504pp., DM 55.00.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translations services, and can supply photoprint or microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

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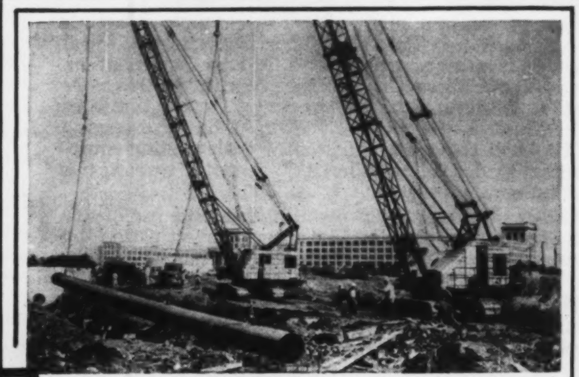

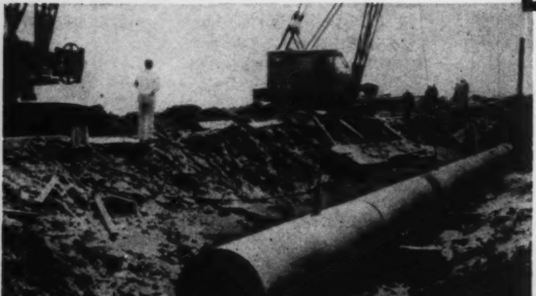

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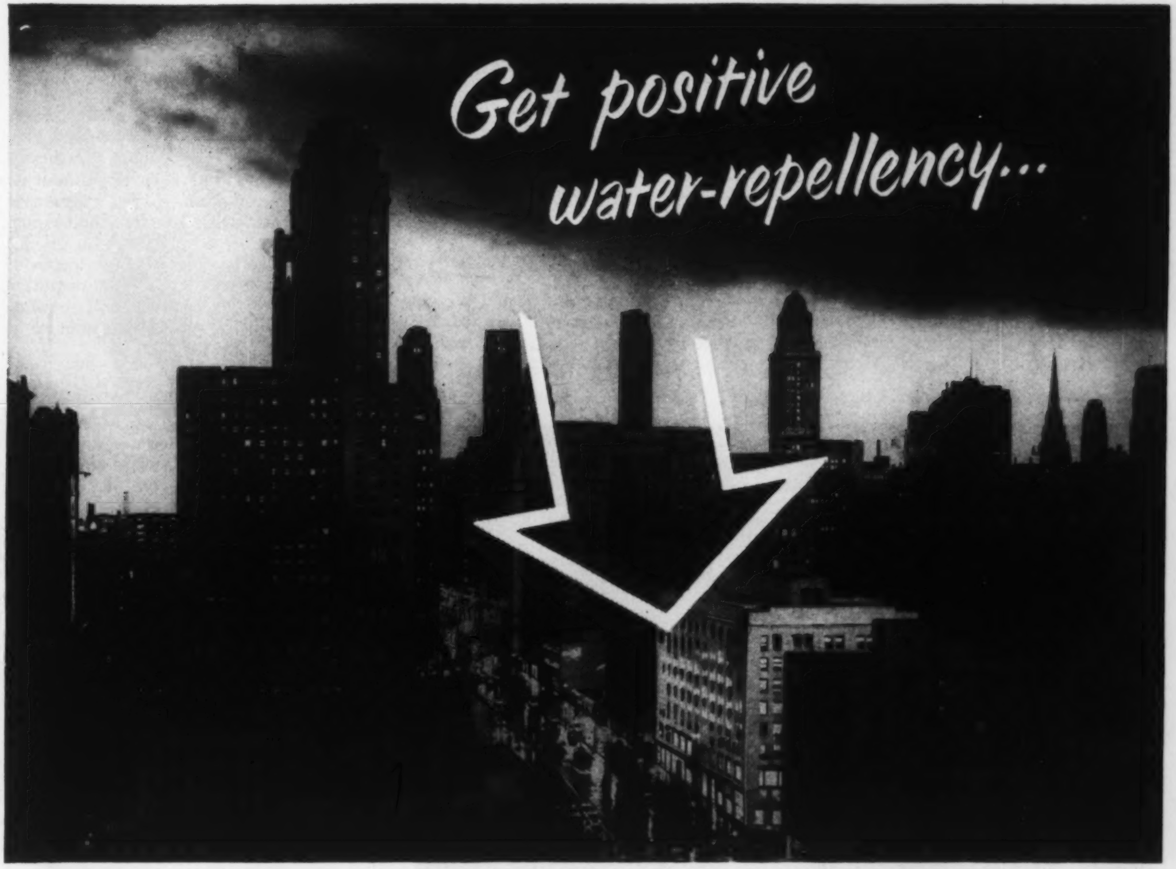

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(SILICONE-BASE)

Hydrocide S•X penetrates into the surface to make the masonry itself water-repellent. It minimizes the effects of weathering and discourages the adhesion of dirt and grime, preserving the original beauty, color and texture of exterior brick and masonry.

Before you buy or specify any water-repellent, consider these facts:

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- Sonneborn issued the first *performance* specifications ever drafted for a silicone-base water-repellent; this specification has served as the model for the industry.

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The use of Hydrocide S•X on many millions of sq. ft. of brick, concrete, block and stucco surfaces confirms its eminently satisfactory performance.

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Location____________________

City__________ **Zone**____ **State**________

News of Engineers

(Continued from page 26)

land where he served as project director on the rehabilitation of numerous air field pavements for the U. S. Air Force. General Elliott retired in July as commanding general, Aviation Engineer Force at Wolters Air Force Base, Texas.

William J. Hedley has been promoted from assistant chief engineer of the Wabash Railroad, St. Louis, to chief engineer. Mr. Hedley is a new Director of ASCE. His home is in Clayton, Mo.

Henry A. Denny, vice-president and assistant general manager of Koppers Company, Inc., Pittsburgh, Pa., was recently appointed to the executive committee of the National Constructors Association. This organization is composed of leading engineering and building firms engaged in the design and construction of chemical plants, petroleum refineries, steel mills and power plants.

Robert H. Uhl is in charge of a new office opened by J. Stephen Watkins Consulting Engineers of Lexington, Ky., in Lansing, Mich. Prior to his new appointment, Mr. Uhl was office engineer at the firm's Valparaiso, Ind., office. The Lansing office is located at 533 North Clippert Street.

George W. Hankinson, associate professor of civil engineering at Northeastern University, has been appointed assistant dean of Northeastern's Graduate Division of the College of Engineering. In addition to assisting the dean in conducting interviews, setting up courses of instruction, and other administrative functions, Dean Hankinson will continue his teaching duties for the remainder of the current academic year.

Charles F. Niles, Jr., has joined Henry B. Steeg & Associates, Inc., of Indianapolis, Ind., as associate engineer on water and sewage projects. Mr. Niles has been with the City of Muncie, Ind., for the past three years as superintendent of sewage treatment, and resident engineer of the plant expansion program.

Raymond C. Regnier and **Henry A. Naylor, Jr.,** have been admitted to partnership in the engineering firm of Whitman, Requardt and Associates of Baltimore, Md. **Roland A. Clark, Charles F. Millard, Roger T. Powers** and **Nevin S. Weiss** have been appointed associate engineers in the firm. All have been with the firm from six to eighteen years.

Roger M. Wells, civil engineer assigned to the Division of Fill Operations, Bureau of Waste Disposal of the City of New York, has been appointed engineer-in-charge of the Division. He was formerly structural engineer with Merritt, Chapman & Scott of New York.

B. A. Weiss, executive engineer and general superintendent of the Imperial Irrigation District in California, will go to Iran in April as engineer in charge of the resource development program being carried on there by the Development and Resources Corp., of New York City. He will begin his new duties in Iran in April.

Paul D. Schlenker has joined the Hercules Concrete Pile Company, of West New York and Palm Beach, as general manager. He has been active in foundation engineering and construction since 1934, and in World War II served in Europe as a unit commander in the Corps of Engineers.

Barton H. Shaw, Raymond J. Lenz, William H. Pugh, William C. Teagle, and **Robert L. Ballew** are now in engineering practice under the firm name of Shaw, Lenz and Associates, with offices at 631 Walnut Street, Cincinnati 2, Ohio.

COLUMN-FREE FLOORS
START IN THE SKY

With the use of Haven-Busch T-Chord Longspan* Joists you can plan clear, column-free floor areas up to 150′ wide. T-Chord Longspan Joists open new vistas for large, uncluttered interiors and offer wide latitudes for planning built-in lighting, insulating and ventilating systems. See our Sweet's File or write for our catalog.

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BUILDS A BIG ONE . . .
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The Spocari, Alabama, plant of The Lone Star Cement Company is one of the largest in the South. Its construction is unique in many ways . . . designed to take full advantage of the most modern methods of materials handling. The framework of structural steel, fabricated by Ingalls, plays a truly important part in the functional design. It provides support for massive equipment as well as backbone for the buildings themselves.

This is another example of Ingalls skill and ability . . . to meet fabricated steel requirements, for any type of construction, regardless of size or location.

Ingalls can serve you better . . . for complete information regarding *why* and *how*, write:

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Capacity has been increased nearly 70% at Ingalls' Plants within the past three years . . . part of a program designed to give Ingalls the facilities to meet every modern requirement for fabricated structural steel for any construction purpose.

THE INGALLS IRON WORKS COMPANY
Established 1910
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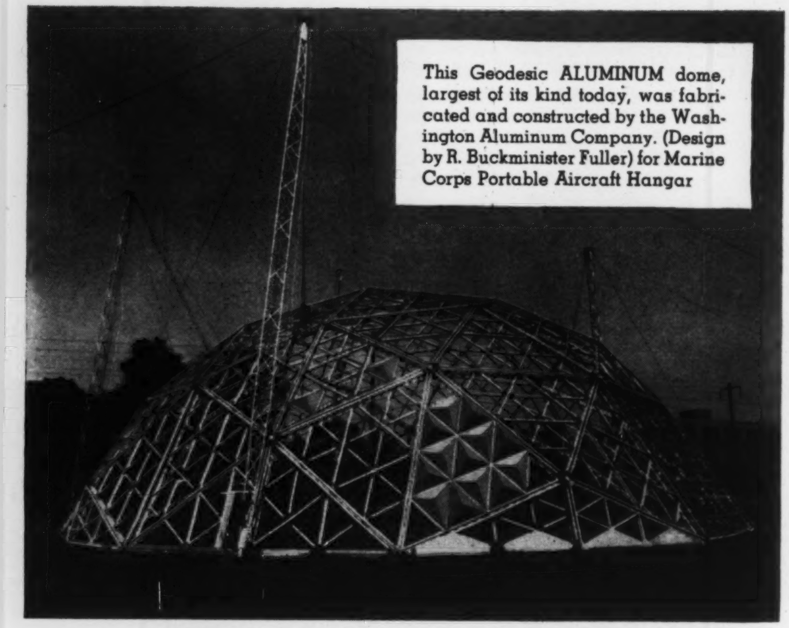

This Geodesic ALUMINUM dome, largest of its kind today, was fabricated and constructed by the Washington Aluminum Company. (Design by R. Buckminister Fuller) for Marine Corps Portable Aircraft Hangar

WORLD'S LARGEST CLEAR-SPAN DOME!

26 tons of WACO Know-how!

Construction of this revolutionary Marine Corps portable aircraft hangar, illustrated WACO's engineering skill, unequalled aluminum fabricating facilities and thorough workmanship. The dome covers 14,700 sq. ft., weighs 26 tons, is stressed to withstand winds up to 150 m.p.h., and will support the weight of a jet fighter suspended within. The skin is fiberglas bonded with plastic.

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WACO is America's only company fabricating aluminum exclusively. This specialization means undivided attention to your engineering problems, the widest range of experience, complete manufacturing "know how".

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Non-ASCE Meetings

American Materials Handling Society. Seventh national Materials Handling Exposition at Convention Hall, Philadelphia, Pa., April 29-May 3. Information from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

American Power Conference. Nineteenth annual conference at the Hotel Sherman, Chicago, March 27-29, under sponsorship of the Illinois Institute of Technology and nine national and regional technical societies. Information from E. R. Whitehead, Secretary, American Power Conference, Illinois Institute of Technology, 3300 Federal Street, Chicago 16.

American Society for Metals. Tenth Western Metal Exposition at the Pan-Pacific Auditorium, Los Angeles, Calif., March 25-29. Information from ASM offices, 7301 Euclid Ave., Cleveland, Ohio.

American Society of Mechanical Engineers. Spring meeting at the Dinkler-Tutwiler, Birmingham, Ala., April 8-10. Information from the ASME, 29 West 39th Street, New York 18, N. Y.

American Society of Mechanical Engineers. Second Design Conference will be held in conjunction with the Design Engineering Show at the New York Coliseum, N. Y., May 20-23. Information from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

American Society of Planning Officials. National Planning Conference at the Sheraton-Palace Hotel, San Francisco, Calif., March 17-21. Information from ASPO, 1313 East Sixtieth Street, Chicago 37, Ill.

American Welding Society. 1957 National Spring Meeting will be held in conjunction with the Fifth Welding and Allied Industry Exposition, Philadelphia, April 8-12. Information from AWS, 33 West 39th Street, New York 18, N. Y.

Building Research Institute. Sixth Annual Meeting will be held at the Drake Hotel, Chicago, Ill., April 15-17. Information from Building Research Institute, 2101 Constitution Avenue, Washington 25, D. C.

Louisiana State University. Twentieth Annual Short Course for Superintendents and Operators of Water and Sewerage Plants, March 20-22. Eleventh Annual Industry-Faculty Conference, March 28-29. Information from Frank T. Carroll, Jr., Assistant to the Dean, Louisiana State University, Baton Rouge 3, La.

(Continued on page 132)

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DOWEL BASKET ASSEMBLIES

Universal Dowel Basket Assemblies are designed and fabricated to specifications. Special equipment and fixtures guarantee accurate spacing and positive alignment of dowels. High speed production equipment and modern facilities insure prompt delivery of your requirements. Universal Baskets are approved by Federal, State and private authorities for highway and airport construction.

Let us quote on your requirements. Write for complete details today.

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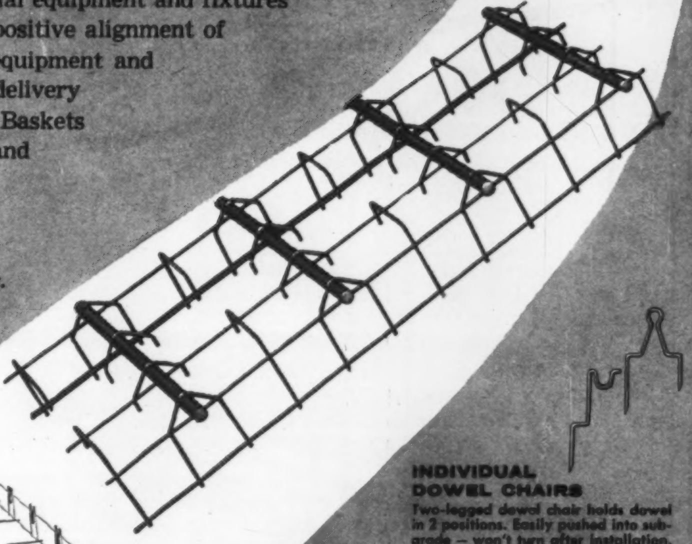
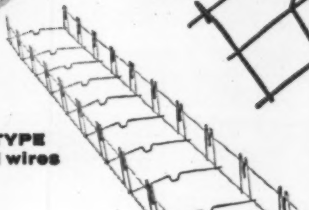
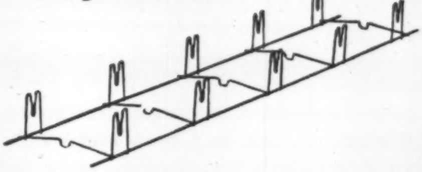




STANDARD TYPE
4 longitudinal wires

STANDARD TYPE
2 longitudinal wires



INDIVIDUAL DOWEL CHAIRS

Two-legged dowel chair holds dowel in 2 positions. Easily pushed into subgrade — won't turn after installation. Wide range of heights.

Single Leg Dowel Chair permits quick snap-in of Dowel. Sizes to support Dowel from 3" to 6" above sub-grade.

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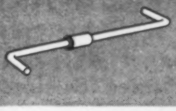
Metal Dowel Sleeves for covering ¾" Dowel Bars; overall length covers 2½" or 3" Dowel. Special sizes and lengths available.



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For providing required tieing element along longitudinal joint. Eliminates necessity of bending tie bars or drilling road forms.

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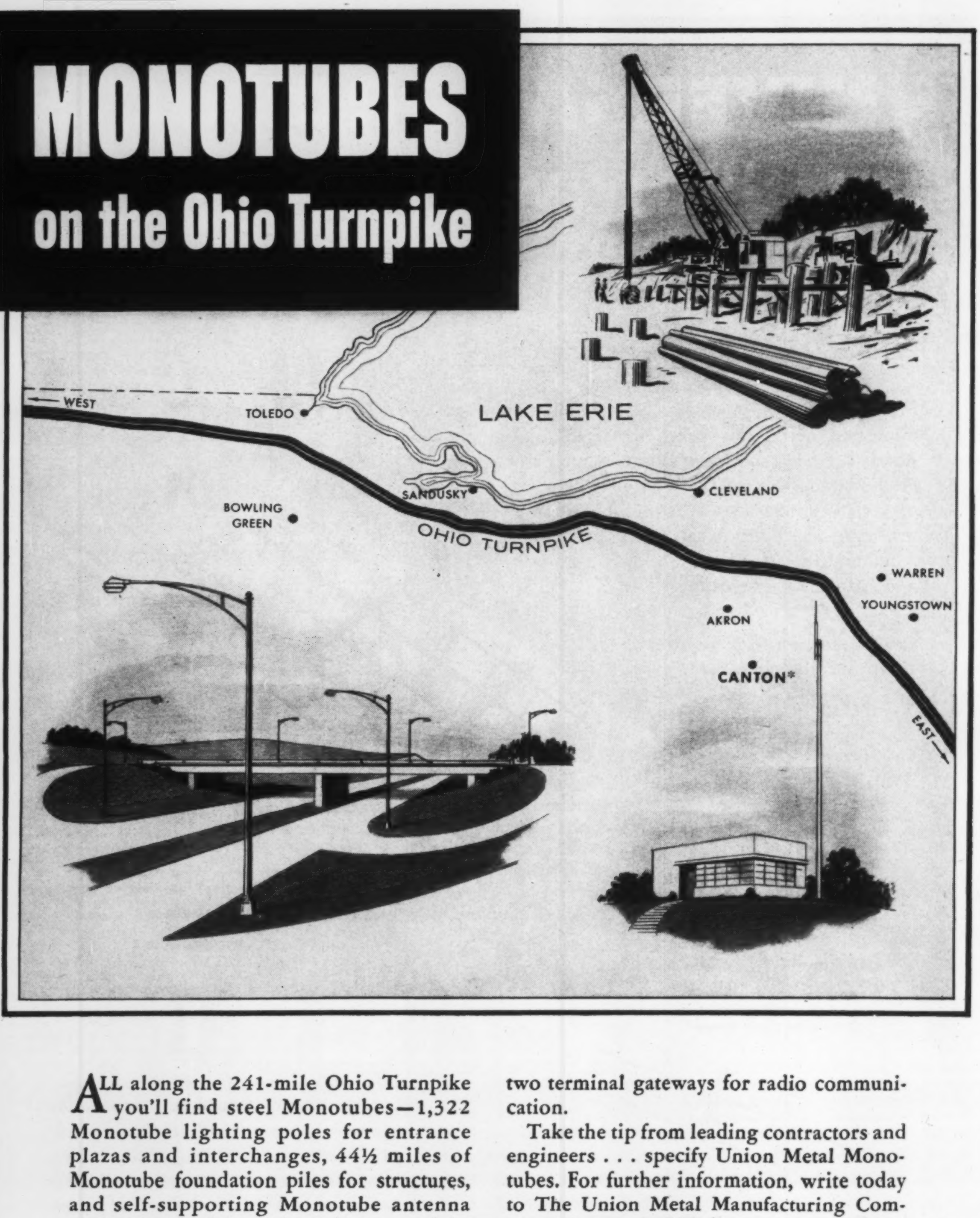
on the Ohio Turnpike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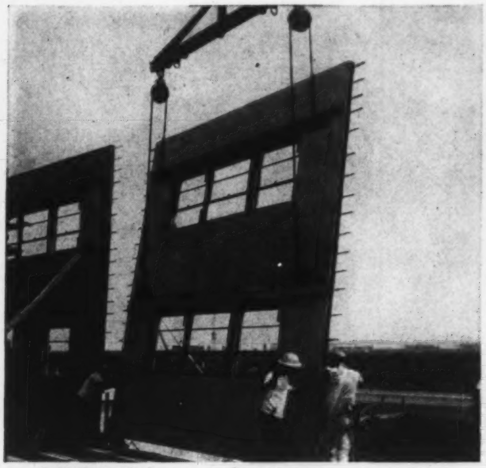
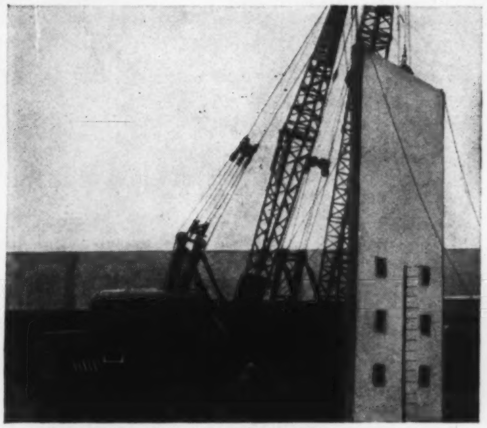


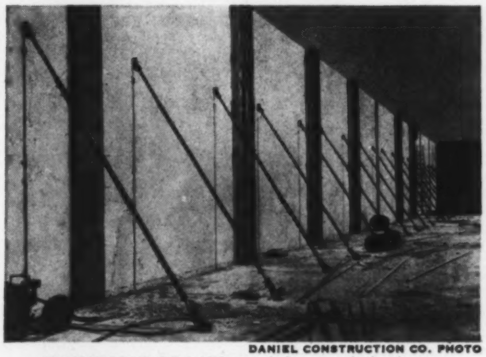
PANEL with large window areas

WAREHOUSE

DANIEL CONSTRUCTION CO. PHOTO



57 TON SLAB being positioned



DANIEL CONSTRUCTION CO. PHOTO

ADJUSTABLE BRACES used for quick and easy alignment of panels

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When an outstanding Tilt-Up job rates an article in a construction publication you can be almost certain that SUPERIOR products were used. The reason is simple. SUPERIOR, as the pioneer in this field, developed designs that were thoroughly tested both in the laboratory and the field to assure safety with economical prices and low application costs.

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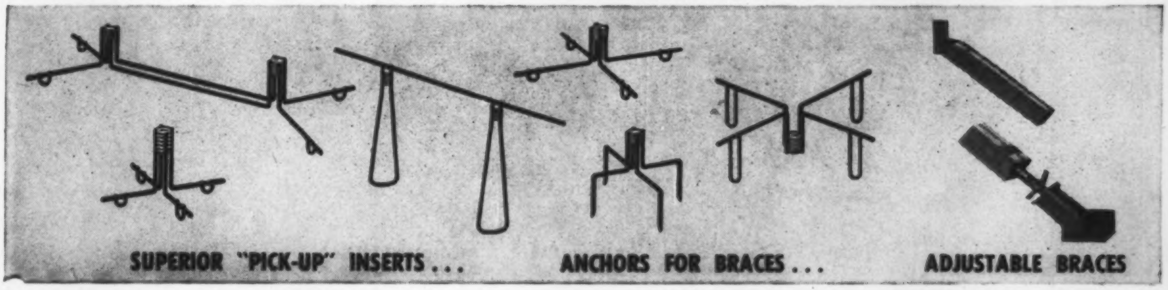

Pike's Peak overlooks east side of Ute Pass in Colorado.
Motorists travel highway safely, securely on asphalt.

Tourist attraction in Colorado—

Good Roads with STANDARD Asphalt

Motorists want good roads. They like to drive on asphalt. Contractors building roads in Mid-America benefit by specifying STANDARD Asphalt. Here's why:

1 **Assured source of supply.** Standard Oil has a demonstrated record of deliveries on contract. Contractors know that when they order from Standard, they have an assured source of supply.

2 **Convenient source of supply.** Tank car and tank truck deliveries are made from five conveniently located Standard Oil refineries.

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3 **Complete line.** Standard Oil makes a full line of paving asphalts. They meet most rigid requirements.

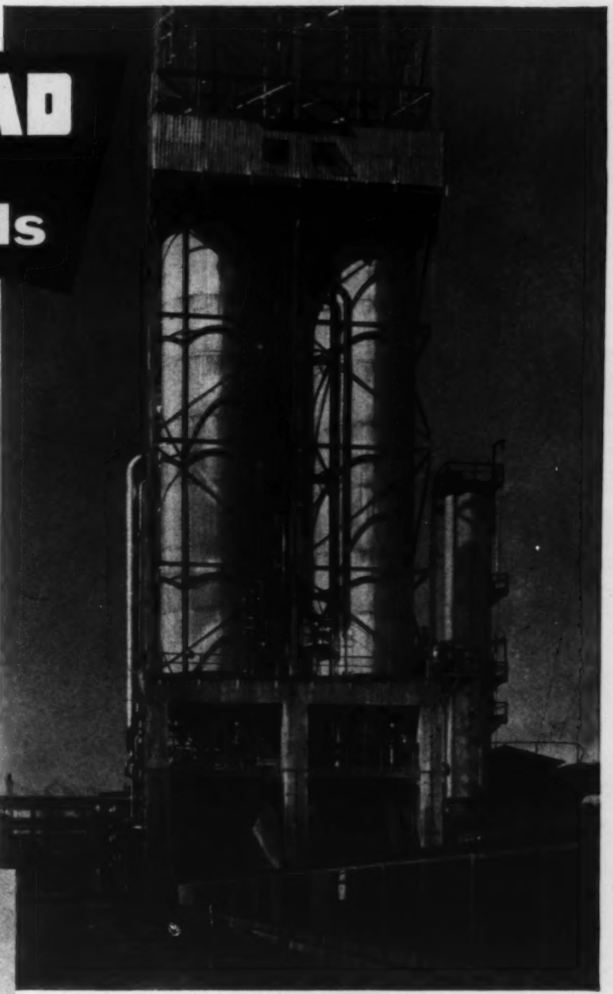
4 **Experienced asphalt sales specialists.** Standard Oil men who sell asphalt know road construction, know what a contractor's needs and problems are. They know how and what to do to give a builder service on asphalt.

Get more information about the advantages of ordering STANDARD Asphalt. Call any of the 23 Standard Oil offices in the 15 Midwest or Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)

STANDARD

HORTONCLAD and CB&I Vessels



Hortonclad Plates Utilized in fabrication of crude fractionator and coking chambers

Hortonclad®, a composite corrosion-resistant metal having an integral and continuous bond produced by a high vacuum brazing process, was used in the fabrication of the two process vessels shown here, built by CB&I.

Hortonclad, available only with CB&I storage and process vessels, may be had in silver, nickel, stainless steels (both chromium and chromium-nickel) and a wide variety of other metals and alloys. Further information on its use with CB&I vessels may be obtained by writing our nearest office.

▲ **405 STAINLESS STEEL HORTONCLAD** was used in the fabrication of these two 16-ft. diam. by 65-ft. high coking chambers by Chicago Bridge & Iron Company.

◀ **MONEL HORTONCLAD** and **CHROME-NICKEL STAINLESS HORTONCLAD** were used in building this 15½-ft. by 142-ft. crude fractionator by CB&I. The top head and upper portion of the shell was Monel Hortonclad. Chrome-nickel stainless Hortonclad was used in the bottom head and lower portion of the shell.

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.
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360
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BID LOW *with help like this . . .*

- MOST POWER PER YARD . . . most power per pound in its class
- MOVES FULL LOADS AT FULL SPEED
- WIDE OVERLAP IN GEAR RANGES...for easy shifting, smooth acceleration
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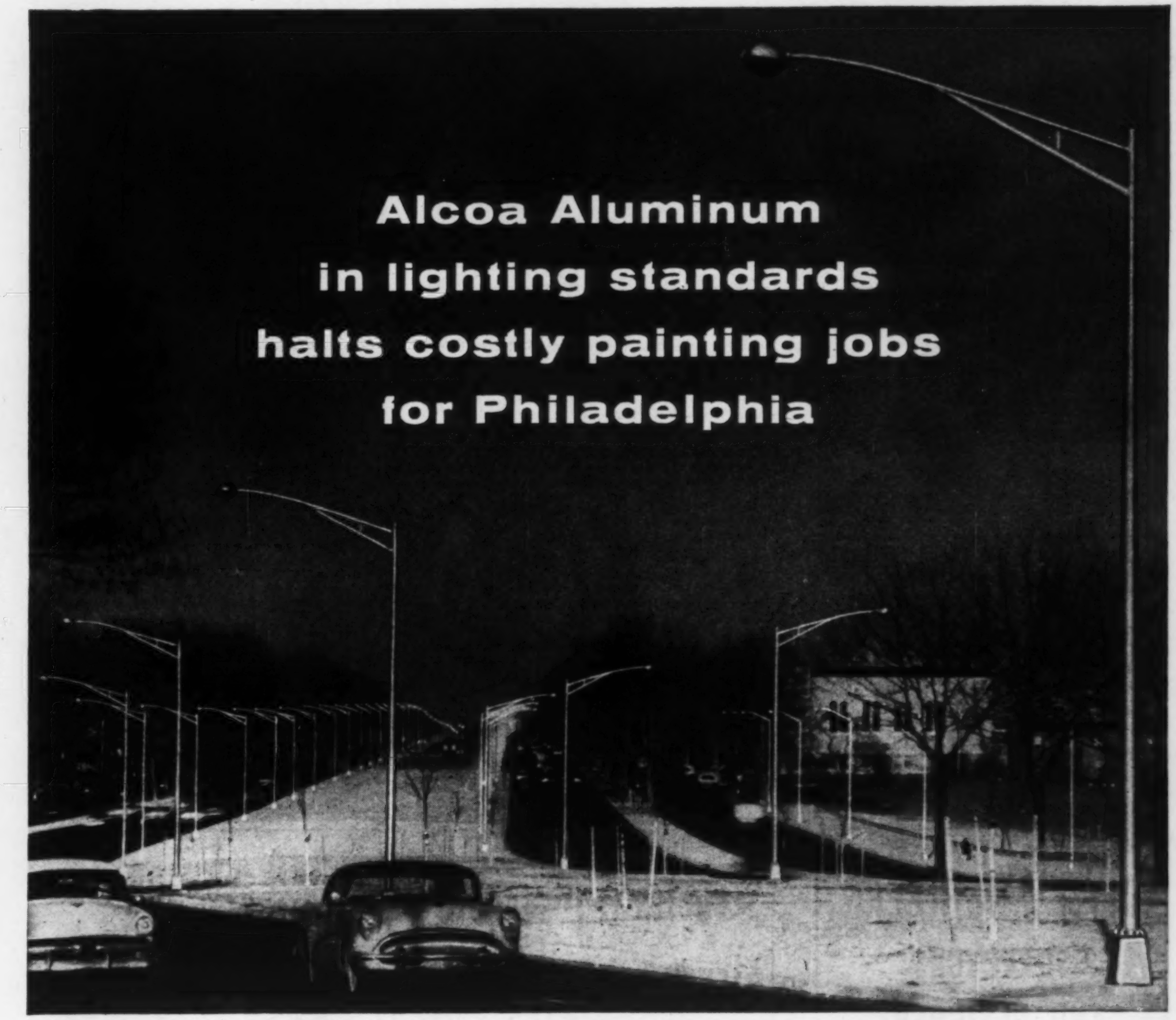
This is the Allis-Chalmers TS-360 . . . a motor scraper that has proved it can help you handle big, tough jobs on rubber . . . profitably. As bidding gets tougher, be ready with the best . . . TS-360's. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*



Alcoa Aluminum in lighting standards halts costly painting jobs for Philadelphia

When Philadelphia relied on steel for lighting standards, each pole ran up a contract painting maintenance bill of $12.00 every two or three years. This ended in 1951, for in that year the City of Philadelphia switched 100% to lighting standards of aluminum . . . both for replacements and new installations.

That means no more painting—ever! Aluminum is free from corrosion that weakens wall strength and ruins appearance. No scale piles up in the interior to threaten electrical circuits. And light weight makes erection so inexpensive that first cost is generally comparable with cheaper but heavier metals.

Philadelphia already has 3,000 aluminum lighting standards in service. Included are 1,000 on beautiful Roosevelt Boulevard and another 500 at National Airport, where even the 92 mph winds of "Hurricane Hazel" inflicted no damage. Hundreds more are due for installation as the city remodels its lighting system.

Alcoa® does not make lighting standards, but supplies aluminum for their manufacture to leading companies. For the names of these firms, write to: Aluminum Company of America, 1979-D Alcoa Building, Pittsburgh 19, Pennsylvania.

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

Project Engineer-Manager (Owner's Representative), J.M. ASCE; 31; 7 years' varied construction experience, as engineer and superintendent. Last 4 years as owner's representative on site selection, retaining architects, supervision of construction and administration of contracts.

Civil Engineer, J.M. ASCE; B.C.E.; 32; registered P.E.; married; 5 years' diversified design experience of industrial buildings and related works, including field checking of own design. One year highway and railroad relocation design. Desires affiliation with small consultant or responsible position with management potential in industrial concern. Location desired: South. C-190.

Field Engineer, J.M. ASCE; B.S.C.E.; 24; 11 months in plant-engineering department of large chemical corporation surveying and mapping plant utilities; 2 years as commissioned officer (active duty) in U. S. Army Corps of Engineers. EIT in Illinois. Location desired: foreign. Available in June 1957. C-191.

Project Manager or General Superintendent, A.M. ASCE; B.C.E.; 49; 25 years in construction industry, general superintendent or project manager. Industrial and monumental structures; 3½ years' design in concrete and steel, power houses, schools, gas plants, banks, etc. Experience with trowel trades, piles, and miscellaneous iron. Two years in architectural college. Location desired: New York metropolitan area. C-192.

Civil Engineer, A.M. ASCE; B.S.C.E.; 35; 11 years' experience in subdivision work with largest home-building company including surveying, layout, computing, estimating, design of utilities. Interested in administrative or supervisory position. Location desired: East, but will consider Midwest or West. C-193.

Structural Design and Construction Engineer (industrial type), J.M. ASCE; B.S.C.E.; 33; 2½ years' detail and design, bridges; 6 years water supply administration and construction; registered Professional Engineer, New York State. Location desired: East, Mid-South, Midwest. C-194.

Civil Engineer-Highways-Technical Sales Promotion, A.M. ASCE; B.S.C.E.; 46; 18 years civil engineering including municipal, county, and state water works, sewage, highways, bridges; 4 years technical sales—concrete. Registered Professional Engineer. Location desired: East or Midwest. C-195.

Research and Development in Civil Engineering, A.M. ASCE; Ph.D. in C.E.; 42; 10 years structures and materials research; 2 years heavy construction; 4 years teaching and administration in applied mechanics; 4½ years highway engineering. Interested in directing research in building materials or transportation field. Location preferred: Midwest. C-196-788-Chicago.

Administrative Engineer, A.M. ASCE; 37; 4 years college; chief estimator, engineer, industrial engineer. Construction supervision. Location desired: California. C-197-790-Chicago.

Office Engineer, J.M. ASCE; B.S.C.E.; 27; experience as construction superintendent, materials testing lab work and army officer. Location desired: Duluth, Minn. C-198-789-Chicago.

Positions Available

Civil Engineer, 25-30, graduate, with either structural or civil engineering background, with a minimum of 6 years in engineering work, 2 years of which must have been in design. Design experience in industrial construction and of the type gained in consulting work. Work will include design of foundations and structures for marine and dockside facilities, industrial and power plant buildings, and equipment foundations. Salary, $6,000-$8,400 a year. Location: Virginia. W-4502.

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Experienced rodmen, chainmen, instrumentmen, designers and draftsmen for permanent highway work. Considerable choice of location in Washington State. Good opportunity for advancement. Progressive, non-political merit system. Minimum of 12 working days each of vacation and sick leave per year. Retirement system. Five step automatic increase wage schedule. Minimum entrance salaries $349 for rodmen and chainmen and $414 for instrumentmen; higher starting salary possible depending on experience and/or education. Also can use recent C. E. graduates or experienced designers for bridge design work in Olympia. Some openings for highway construction inspectors, soils men, planning and traffic engineers. Write for application blank to Wm. T. Read, Personnel Officer, Washington State Highway Department, Transportation Building, Olympia, Washington. State preference of location and type of work in your letter.

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Structural Draftsmen

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Opportunity for continuing employment in all grades in our design offices located in Louisville, Cincinnati, Chicago and Lansing for graduate engineers with or without experience and individuals with practical backgrounds for work on major bridges and expressway projects.

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Overtime allowance, annual vacation with pay, holiday time, allowance for sick leave, insurance and retirement plan, Blue Cross available.

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Desirable living and working conditions. Ample opportunity for advancement to positions of responsibility.

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Please give detailed personal and experience record, competent references and salary expected in first letter.

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HAZELET & ERDAL
Consulting Engineers

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Louisville, Kentucky

Highway Engineers for a consulting engineering firm. (*a*) One Bridge Engineer and one Highway Engineer with experience in designing, supervising, and coordinating staff of design engineers. Salaries, $7.200-$8.000 a year. (*b*) Highway Structures and Bridge Design Engineers and Highway Design Engineers with 3 to 5 years experience in these fields. Salaries, $6.000-$7.000 a year. Apply by letter giving complete data, date of availability, etc. Location: West. W-4503—S.

Instructor, graduate civil, for duties including lecturing, laboratory supervision and also assisting for three weeks at surveying camp; subjects of instruction are first-year engineering drawing, a second-year course in surveying, and a course in materials of construction. Previous teaching experience not essential. Write giving full details of training and experience. Temporary, from August 1957 to mid May 1958. Salary, for this period, $4,450. Location: Canada. W-4507.

Instructors or Assistant Professors for civil engineering department; masters degree and teaching experience desirable but not required. Will teach courses in one or two of the following areas: Surveying, structures, hydraulics or transportation. Nine-month year; salaries open, depending upon education and experience. Positions available September 1957. Location: New York Metropolitan area. W-4518.

Civil Engineers, young, with from 2 to 10 years experience in heavy construction, for work on a dam project. Work will consist of material and quantity take-off, some drafting, field inspection of embedded materials, labor and equipment field recording for cost analysis and construction progress reporting. Salaries open. Location: New York State. W-4538.

Senior Engineer, Civil, to 40, graduate, with approximately 7 years experience in applicable fields, primarily work in soil mechanics, foundation and structural analysis or design. Will work on design of new reduction plant facilities or modifications or additions to existing facilities, etc. Salary open. Location: California. W-4539.

Engineer with 15 or more years experience in the cement industry; previous experience in cement plant design, especially those using coal as fuel; good knowledge of modern plant equipment; for planning and design of a cement plant. Salary open. Location: South America. F-4542.

Senior Project Designer, civil graduate, with at least 5 years reinforced concrete experience covering concrete pipe, storage tanks and heavy construction. Salary, $8,000-$10.000 a year. Location: New York, N. Y. W-4550.

Valuation Engineer, graduate civil or mechanical, 28-45, with some practical experience in pricing or estimating current costs of utility property; either with utilities, appraisal or engineering companies, or regulatory commissions. Some construction work and knowledge of cost accounting desirable. Will participate in the development of unit costs, such as material, labor and overheads, applicable to the inventory quantities of natural gas utility properties. Salary, to $8,400 a year. Some travel. Location: Ohio. W-4565.

Research Assistants and Teaching Assistants. Opportunities for full or part-time employment on government contracts in mechanics with emphasis on elasticity, vibrations, and electronic instrumentation. Some applied mathematics or electro-mechanical experience desirable. Part-time teaching assistantships available for undergraduate instruction. Graduate study commensurate with research duties available in engineering mechanics leading to masters degree. Salary, to $6,000 for full time for 12 months employment. Location: South. W-4574.

Sales Engineers, 24-30, civil graduates, with concrete experience, for technical field work with customers of cement manufacturer. Salary, $4,800—$6,000 a year, plus expenses and company car. Location: Northeast. W-4600.

Engineers for large project where the work will consist of heavy reinforced concrete structures, portions of which are below the groundwater level. (*a*) Project Manager. Salary, $12,000-$18,000 a year. (*b*) Construction Superintendents. Salary, $8,000-$15,000 a year. (*c*) Office Manager, Accounts, etc. Salary, $6,000-$12,000 a year. (*d*) Cost Engineer. Salary, $6,000-$8,000 a year. (*e*) Purchasing Agents, Expediters. Salaries, $8,000-$12,000 a year. Location: South. W-4608.

Engineers. (*a*) Structural Engineer, graduate civil, with at least 5 years experience in hydroelectric structures, to check contractors detailed drawings in field, determining minor design changes, recommend any major changes dictated by field conditions. Prefer single status but will consider married man. Transportation paid. Salary, $12,000 a year, plus 700 lira per month. Two-year assignment. Location: Middle East. (*b*) Concrete Engineers, two, to design concrete mixers for concrete dam and associated structures including admixers. Will supervise field sampling and laboratory tests, supervise cooling placing and joint treatment. Will prepare aggregate gradation reports, supervise quantities and plant operations. Preferably single status. Salary, $12,000 a year, plus monthly living allowance. Two-year assignment. Locations: one for South America; one for Middle East. F-4624.

Specification Writer, 35-50, to write specifications and contract documents on irrigation, navigation, hydroelectric and building projects. Will make quantity surveys and cost estimates on this work. Should have had experience in specification writing on heavy civil engineering structures as well as mechanical features. Duration, 17 months. Salary, $12,000 a year plus monthly living allowance. Location: Middle East. F-4625.

Civil Engineers for building contractors. (*a*) Graduate civil, 27-37, with experience in estimating, operations and sales for immediate estimating-operations position with some sales responsibilities leading to later full time sales position and eventually to considerable responsibility for management of company sales program. (*b*) Graduate civil, for position as estimator and assistant to project manager. Experience in layout of multi-story reinforced concrete frames for position as field engineer leading to later opportunity as superintendent or office engineer. Location: New York, N. Y. W-4628.

Engineers. (*a*) Materials Engineer with construction experience preparing specifications, requisitions, controls, and reports covering construction materials, chemical and metal fabrication equipment. Salary, $7,500-$9,000 a year. (*b*) Estimator with industrial building take-off and pricing covering chemical plants and mill construction. Salary, $7,000-$8,500 a year. Location: New York, N. Y. W-4629.

Civil Engineer, graduate, 30-40, for long-established engineering organization. Experience in highway and municipal fields or concrete structural design is necessary. Reply by letter giving résumé of education, engineering experience, and salary requirement. Location: New York State. W-4635.

Field Engineers, three, preferably under 30, graduate civil or arcchitectural, preferably with a major in structural design; with from none to a few years experience; must be qualified to understand problems of design in structural steel; be interested in promotional work and able to present subject well. Salary open, plus fringe benefits. Company pays placement fees and relocation expenses. Location: one for Philadelphia, Pa., one for Chicago, Ill., and one for Los Angeles, California. W-4636-C.

Building Management Operation and Maintenance Engineer, 35-45, engineering graduate, with P.E. license and at least 10 years experience covering office building operations, planning of new construction and alterations, estimates and staff administration. Salary, $12,000-$13,000 a year. Location: New York, N. Y. W-4649.

Chief Squad Design Engineer, B.S.C.E., preferably 6 years in highway structures or highway grade and geometric design; know highway design and construction. Duties will include overall design supervision and directing squad of junior designers and draftsmen with occasional field trips; occasional travel; car preferred; for a consulting engineer. Salary, $6,600-$8,400 a year. Company pays placement fee. Location: Nebraska. C-5980.

Engineering Teacher, Civil, with M.S. and teaching experience, for lower division courses in engineering department of large junior college. Salary, about $5,500 for nine months. Location: central California. S-2617.

ENGINEERS . . .

Caterpillar Tractor Co., the world's leading manufacturer of earthmoving equipment, has openings for Civil and other engineers to fill responsible Sales Promotion and Dealer contact positions in both the United States and foreign countries. Advancement and security are certain for qualified men. Salaries and other benefits are well above the industry average. Accepted men are given thorough and diversified training in preparation for a stimulating career.

Applicants should be willing to travel. An engineering degree or considerable practical experience is required. Men 35 or under preferred, but positions are not restricted to this age group. Engineers interested in challenging careers with the leading manufacturer of heavy construction equipment should send full particulars of experience and education to Mr. R. R. Haarlow, Professional Employment Co-ordinator. All inquiries will be treated on a confidential basis.

Employment Division

Caterpillar Tractor Co.

Peoria, Illinois

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YOUR TRAINING IN STRESS AND WEIGHT CAN BRING YOU A REWARDING CAREER

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NUCLEAR
PROPULSION

AT GENERAL ELECTRIC

If you've been thinking that the development of nuclear propulsion systems for aircraft is out of your line, you've overlooked a chance to get into a fast-growing field with a wide-open future.

General Electric's expanding Aircraft Nuclear Propulsion Department, already at the product stage, offers a rare opportunity for men with sound engineering skills, whether or not they have nuclear experience.

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. . . through a full-tuition refund plan for university courses leading to an M.S. in nuclear engineering or any other graduate degree, and in-plant training courses conducted by the top men in the nuclear field. On the job you'll work with experts who'll guide you in applying your present skill to the problems at hand.

Comprehensive employee benefit programs—High starting salary—Relocation expenses paid—Periodic merit reviews

Civil engineers have new horizons today. Act now to assure yourself the kind of future you've always wanted — in a field that is changing the course of aviation history.

Reply in confidence, stating salary requirements, to location you prefer:

J. R. ROSSELOT
P.O. Box 132
Cincinnati, Ohio

L. A. MUNTHER
P.O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

Non-ASCE Meetings

(Continued from page 122)

North Carolina State College of Agriculture and Engineering. Sixth Southern Municipal and Industrial Waste Conference at the new College Union Building, April 1-2. Information from Nelson L. Nemerow, Chairman, School of Engineering, Raleigh, N. C.

Purdue University. Purdue Industrial Waste Conference at the Purdue Memorial Union Building, May 13-15. Information from Don E. Bloodgood, Professor of Sanitary Engineering, Purdue University, LaFayette, Ind.

University of Florida. Tenth Municipal and Sanitary Engineering Conference on the campus of the University, March 19-20. Information from E. R. Hendrickson, Conference Chairman, University of Florida, Gainesville, Fla.

Positions Announced

Army Corps of Engineers. The Buffalo District has a few openings for qualified office and field engineers looking for positions of security with diversified assignments in the government service. With the advent of the St. Lawrence Seaway and the Connecting Channels together with an increased work load, more engineers are needed now. Positions are available at starting salaries of $6,115 and $7,035 per annum. Applicants should write or contact the District Engineer, U. S. Army, Engineer District, Buffalo Corps of Engineers, Foot of Bridge Street, Buffalo 7, N. Y.

Army Corps of Engineers. The Sacramento District has openings for engineers in the Sacramento District in connection with planning, design and construction of military and civil projects. Sanitary Engineer GS-819-11; 3 Structural Engineers (bldg) GS-812-9 and 11; 3 structural engineers (hyd str) GS-812-9 and 11; supervisory civil engineer (levee design) GS-810-11; civil engineer (utilities) and (soils mech) GS-810-9 and 11; civil engineer (estimates) GS-810-9; civil engineer (specs) GS-810-9 and 11, and hydraulic engineer (design) GS-813-9 and 11. Standard Form 57 obtainable at any post office or Federal Agency, should be completed and submitted to District Engineer, Sacramento District, Corps of Engineres, Sacramento, Calif.

U. S. Deparment of Agriculture. The U. S. Agricultural Research Service has an opening in the hydraulic laboratory at Minneapolis, Minn., for a hydraulic engineer to conduct interesting and challenging research on soil and water con-

ENGINEERS
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Highway and Bridge

Excellent advancement opportunities in a long established and progressive consulting firm, for engineers experienced in the design of highways and bridges.

Interesting and challenging permanent assignments. Attractive salaries and liberal employee benefits.

Note: Employees of BPR, state, county or city highway organizations may not be employed without written consent of such public employer.

Write for application blank

CAPITOL ENGINEERING CORPORATION
Dillsburg Pennsylvania

SOUTH DAKOTA DEPARTMENT of HIGHWAYS

Engineering Opportunities

Professional openings on the South Dakota Department of Highways staff present permanent opportunities for Civil Engineering graduates in the following classifications and salary brackets:

Structural Designer $5940-7020
Structural Draftsman $5220-6240
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Benefits include salary schedule, sick leave with pay, paid vacations, military leave with pay, available hospitalization plan.

For application forms, contact:

C. V. DOODY
Personnel Director

Department of Highways
Pierre, South Dakota

servation structures for nation-wide application. This position provides excellent opportunities for professional recognition and advancement. Salary $6,115 to $7,035 (GS-9 or 11) depending on the qualifications of applicant. Applications on Standard Form 57 should be submitted to Project Supervisor, Agricultural Research Service, St. Anthony Falls Hydraulic Laboratory, Minneapolis 14, Minn.

Civil Engineer Corps. The San Diego District has openings at the U. S. Naval Station and Repair Facility for engineers (GS-9-11 and 12). Positions offer numerous promotional opportunities in addition to a variety of challenging technical projects. Salaries (GS-9 $6,115 per year, GS-11 $7,035 per year, and GS-12 $7,570 per year). Information from Navy Civil Engineer Corps, San Diego Disrtict, San Diego 36, Calif.

New Publications

Steel design . . . Issuance of the second edition of the "Light Gage Cold-Formed Steel Design Manual," containing the 1956 edition of Specification for the Design of Light Gage Cold-Formed Steel Structural Members, is announced by the American Iron and Steel Institute. Revision and enlargement of the Specification and the tables, charts, and other information in the manual are the result of the Institute's continuing research program. The present 92-page manual replaces the January 1949 edition. Copies are $1.00 each and may be obtained from the Institute, 150 East 42nd St., New York 17, N. Y.

Reinforced concrete . . . The American Concrete Institute has reprinted in special covers the report, "Guide for Ultimate Strength Design of Reinforced Concrete," by Charles S. Whitney and Edward Cohen. First published in the ACI Journal for November 1956, the report is intended to serve as a supplement to the ACI Building Code (ACI 318-56), which permits the use of the ultimate strength method for the design of reinforced concrete members. The 36-page report (including 15 design charts) in 6 x 9-in. format is priced at 75 cents. To facilitate office use, enlargements of the design charts—approximately 12 by 12 in.—are available in covers at $2.00 per set. Requests should be sent to the American Concrete Institute, P.O. Box 4754, Redford Station, Detroit 19, Mich.

Coast and Geodetic Survey . . . A. L. Shalowitz, editor of the Coast and Geodetic Survey "Journal," announces that for the first time the publication is available to the general public on a sales basis. Currently offered is No. 6, the first issue since June 1953. The 190-page illustrated volume is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at $1.50.

Hydraulics studies . . . A recirculating model water tunnel devised at the St. Anthony Falls Hydraulic Laboratory for the purpose of determining prototype design data for use in planning various types of cavitation test facilities is described in the Laboratory's Technical Paper No. 16, Series B. Lorenz G. Straub, John F. Ripken, and Reuben M. Olson are the authors. Some of the studies reported indicate that the cavitation susceptibility of the tunnel water varies, and show that the critical cavitation index of a slender body is more constant when based on a measured pressure than on vapor pressure. Copies, priced at 75 cents each, may be obtained from the Director of the Laboratory, University of Minnesota, Minneapolis, Minn.

Industrial research laboratories . . . Information on 4,834 industrial laboratories makes up "Industrial Research Laboratories of the United States (1956)," the tenth edition of an annotated directory that has been compiled and published by the National Research Council at intervals since 1920. An index of research activities includes over 1,000 major subject headings. Copies of the 560-page, cloth-bound publication are $10 each, with discounts available to educational, non-profit, and government organizations. Requests should be sent to the National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Cement and concrete . . . A compilation of interesting facts about the history, manufacture, and uses of portland cement and concrete is available in the 1956-1957 "Cement and Concrete Reference Book." The 112-page illustrated publication covers cement and concrete in paving; structural uses of concrete; concrete for housing; farm uses of concrete; concrete in conservation; precast concrete products; and special uses. There are also sections on such related subjects as highway research, highway financing, and highway safety. Inquiries should be sent to the Portland Cement Association, 33 Grand Avenue, Chicago 10, Ill., or to one of the company's district offices.

Atomic developments . . . Availability of two recent bulletins dealing with peaceful uses of the atom is announced by the Technical Information Service of the Atomic Energy Commission (Washington 25, D. C.). Bulletin TID-8010, consisting of the proceedings of the Pressurized Water Reactor Forum held at Mellon Institute in December 1955, sells for 20 cents. Bulletin TID-8013—a monograph by E. B. LaVelle, L. H. Rasmussen, and E. M. Kuchera—details "Developments in Stainless Steel Welding in the Nuclear Program" and sells for 45 cents.

Applications for Admission to ASCE—Dec. 30, 1956-Feb. 2, 1957

Applying for Member

Jaime Amorocho, Denver, Colo.
Boyd Gordon Anderson, New York, N.Y.
Richard McGregor Bigger, Jackson, Miss.
Geoffrey Morse Binnie, London, England.
Paul Bolton, Kansas City, Mo.
Paul Christian Bruhl, New York, N.Y.
James Hunter Cheston, Chattanooga, Tenn.
Charles Franklin Corns, Omaha, Nebr.
Charles Edward Defendorf, Chicago, Ill.
Martin Michael Denn, Hermosa Beach, Calif.
Tha Dok (Lek Piyamedhi), Rangoon, Burma.
William Nestor Fine, Portland, Ore.
John Glendy Fry, Los Angeles, Calif.
Charles Peter Goodwin, London, England.
Glen James Hopkins, Kansas City, Mo.
Talbot Shelton Huff, Austin, Tex.
Stanley Edward Jewkes, Kuala Lumpur, Malaya.
Harold Hiram Jones, Boston, Mass.
Max Klein, New York, N.Y.
Fred Emil Lange, Vallejo, Calif.
Rosaire Joseph Laporte, Detroit, Mich.
Herbert Henry Ley, Chicago, Ill.
Juan Dent Martinez, Jr., San Jose, Costa Rica.
Robert Richard Matheu, San Francisco, Calif.
Basil Alvin McAdams, Miami, Fla.
Timothy Barrette McAuliffe, Glassport, Pa.
Robert Hammiell Naylor, Parkway Station, Miss.
Louis Watkins Prentiss, Washington, D.C.
William Albert Sachs, Pittsburgh, Pa.
Joseph Anthony Salvato, Jr., Troy, N.Y.
Douglas Edward Schneible, Atlanta, Ga.
George Bracken Shaw, Jr., Pittsburgh, Pa.
Wallace Broughton Short, New York, N.Y.
Sven Bollaereu Svendsen, New York, N.Y.
Walter William Tuttle, Honolulu, T.H.
Charles Richard Warndof, Vicksburg, Miss.
Neal Wyer, New York, N.Y.

Applying for Associate Member

James Moser Anderson, Peoria, Ill.
James Robert Beers, San Diego, Calif.
Sanford Norman Belkin, Los Angeles, Calif.
Joe Clay Bridgefarmer, Arlington, Tex.
Robert Creighton Briggs, Boston, Mass.

(Continued on page 134)

HIGHWAY ENGINEERS
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DETAILERS

FOR OFFICE WORK IN ST. LOUIS ON HIGHWAYS, EXPRESSWAYS AND ASSOCIATED CIVIL WORKS

- Permanent employment for qualified men
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Plus: Employee Benefit and Retirement Plan, Paid Vacations,
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1134 LOCUST ST. ST. LOUIS 1, MO.

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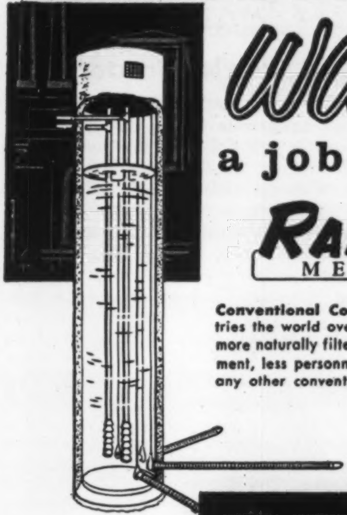

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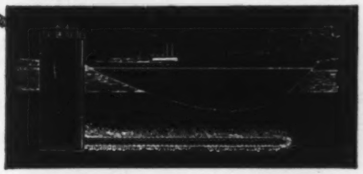

Infiltration Gallery. The gallery, engineered by Ranney, provides industry a low cost water supply. The gallery provides large quantities of clear non-turbid water in a revolutionary yet economical way, and it requires no maintenance.

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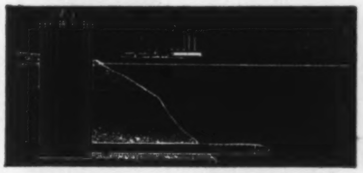
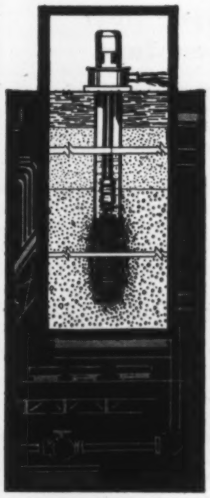


Ranney Intake. The Ranney Intake, already has proven that plants and factories can obtain surface water both efficiently and economically. The Ranney Intake can usually fit into the design of your engineering department or consultant.



Ranney Vertube. Small industry and low volume users can now have a natural gravel vertical water well at low cost. Engineered with the same Ranney precision that has made their method a *must* for industry.

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SURVEY DEPTH RECORDER

For Dredging and Pipe Laying

To meet the requirements for extremely precise measurement of depths and underwater bottom contour in dredging and pipe laying operations, Edo has developed the Model 255A Survey Depth Recorder.

The new Model 255A Depth Recorder is a development of the famed Edo Model 255 which gives precise, continuous indication of depths in any range from three feet to 250 fathoms at speeds up to 15 knots.

The Model 255A employs a transducer which has a beam width of only 6 degrees at the 10 db point, which results in greater detail within a relatively small area. Lessening the penetration of signals into silt or mud gives extremely precise indication of the actual depth and contour of the bottom.

For measuring dredging operations, silt, sharp slopes, the Model 255A is recommended. For general survey, deep depth and penetration, the standard Model 255, with beam width of 20 degrees at the 10 db point and with accuracy within one-half of one per cent, is recommended.

Precise Measurement in 8 Ranges

Edo Models 255 and 255A are manually adjustable for transducer draft or sound velocity and record in eight ranges:

0 to 70 feet or fathoms
60 to 130 feet or fathoms
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Notes can easily be made on chart through large hinged window or positions marked automatically with marker button. One roll of paper operates 10 hours continuously on "foot" scale; 20 hours on "fathom" scale. Equipment is housed in rugged cast aluminum case. Send for brochure today.

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College Point, L. I., N. Y. SINCE 1925

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Power Steering Unit

LATEST PRODUCT INTRODUCED by Sherman is a power steering device for the Fordson Major Diesel tractor. This new unit eliminates side thrusts and shocks which normally tug at the steering wheel and provides easier steering when the front of the tractor is weighted down by a heavy attachment.

Sherman's all-new major power digger, also for the Fordson Major, is a versatile backhoe with a digging depth of 12½-ft, a 180-deg arc of swing and a top reach of 8-ft, 8-in.

Already used by thousands of construction firms, the digger, fork lift and front end loader are handy units around any construction yard. **Sherman Products, Inc., CE 3-138, Royal Oak, Michigan.**

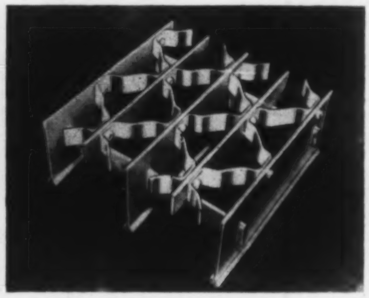
Torque Converter

A TORQUE CONVERTER, comparable to the automatic transmissions on automobiles and which multiplies torque up to four and one-half times and practically eliminates gear shifting for the tractor operator is standard equipment on the HD-21 and optional on the HD-16 crawler tractors which Allis-Chalmers exhibited at the Road Show.

Standard Equipment on HD-21

The torque converter has three main parts—impeller wheel, turbine wheel and stationary housing. The impeller wheel is connected to the engine through the engine clutch and turns at crankshaft speed. The blades of the impeller drive the fluid against the blades of the turbine wheel which is connected to, and drives, the transmission input shaft. The fluid driven by the impeller hit the turbine wheel blades, turning the turbine, and then is thrown against the reactor blades in the stationary housing.

The stationary housing is a fluid-tight case enclosing the entire torque converter unit. When the fluid hits the stationary reactor blades, it is directed back to the impeller wheel, which again drives it against the turbine wheel. **Allis-Chalmers Manufacturing Company, CE 3-138, Milwaukee, Wisc.**



Grating

AMONG THE ITEMS FEATURED at the Road Show were Irving's Sil-Deck grating which is used for bridge decking and highway draingrates. Main bulb beams carry heavy load. Additional bracing is given through transverse bars.

Also included was the standard riveted draingrate. 80 percent open mesh gives rapid drainage of highways. This grating design is also used for standard Irving open steel bridge flooring. **Irving Subway Grating Co., Inc., CE 3-138, Long Island City, N. Y.**

International's Line

THE INTERNATIONAL DISPLAY included a complete line of crawler tractors from the TD-6 through the TD-24 models; International Drott Skid-Shovels and the versatile 4-in-1's; self-propelled scrapers; off-highway haulers, front-end loaders, wheel tractors; diesel and carbureted power units; and attachments used with the equipment.

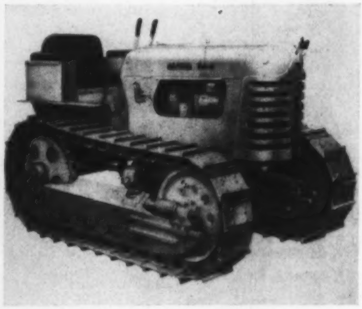
TD-24

Among the units features were: the new Model 12 Payloader, the speedy, crawler-type front-end loader with 1¾-cu yd bucket, the 20-cu yd Model 75 Payscraper, and International's entire line of new diesel powered crawler tractors, which included a massive 200 hp TD-24 torque converter model, largest of their line. **International Harvester Company, CE 3-138, 180 North Michigan Avenue, Chicago 1, Ill.**

Crawler Tractor

NOW IN VOLUME PRODUCTION after thorough nationwide testing on all kinds of jobs, the new OC-4 has many design advancements. While classifying it as a small tractor, Oliver proudly adds that it is by no means small in the size and range of jobs it will do.

Powered with a 21.8 dbhp gasoline engine, it mounts a full range of working attachments, both front and rear. There are 4 lower track wheels to provide maximum track surface contact for greatest push-pull power in heavy going. Extra heft has been put in both the final drive gear chain and the housing itself. The track assembly of the OC-4 includes hardened shoes which combine strength and hardness to give new-record serviceability. The heavy-duty, easy-shift, 4-speed transmission delivers forward speeds from 1.55 to 5.23 mph with 1.80 mph in reverse, for rapid cycle dozing and loading work. **The Oliver Corporation, CE 3-138, 400 West Madison Street, Chicago 6, Ill.**



OC-4

Synthetic Fiber Woven Tape

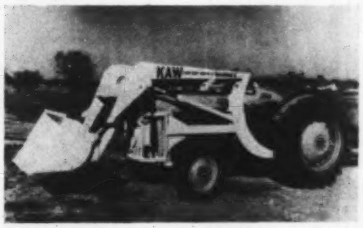
A NEW MEASURING TAPE, known as the Hi-Line, will be of particular interest to road builders and engineers because of its ability to retain its accuracy despite rough usage and abuse. The tape is woven from synthetic yarns, such as those used in modern miracle fabrics that have been selected for their long wearing properties, stability under all conditions, and high dilectric strength. The tape line is a non-conductor of electricity. It is ⅝-in. wide and has bold black and red markings on a white background. The tape is furnished in either a genuine leather case with a rust-resistant metal liner, or in a perforated disc type nickel plated reel for longer lengths. Available in standard lengths from 25 to 150 ft. **The Lufkin Rule Co., CE 3-138, Saginaw, Michigan.**

EQUIPMENT, MATERIALS and METHODS

(continued)

Utility Loader

A NEWLY DESIGNED UTILITY loader for Ford and Ferguson tractors has recently been marketed. The new "Kaw" loader has a 10-cu ft roll-back bucket actuated by twin, 2-in. double-acting cylinders. Lifting cylinders are 2½-in. bore and hoist 1250-lb to 9-ft dumping height. The hydraulic system comprises an 11-gal crank shaft driven pump and permanent piping with 1000 PSI by-pass protection.



"KAW"

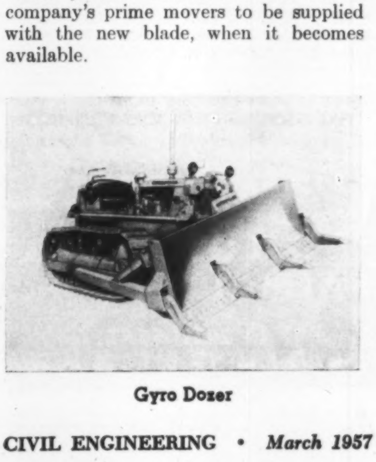
According to Shawnee the operating cycle for the loader is 5-sec to full dumping height, 3-sec to down position. Due to its low cost and simple, two-pin installation, it is said to be ideal for use in application where a single tractor is used frequently with other attachments. **Shawnee Manufacturing Company, CE 3-139, 1947 North Topeka Avenue, Topeka, Kansas.**

New Bulldozer Design

A NEW CONCEPT IN BULLDOZER design was introduced at the Road Show.

Designated the Gyro Dozer, this earthmoving tool combines the functions of ripping and moving material in one bulldozing operation, and eliminates the need for a separate ripping operation. Working in hard to handle material, it produces full blade-loads in less time and shorter distances.

Road Show audiences saw the Gyro Dozer displayed on a Caterpillar D7 Tractor, which will be the first of the company's prime movers to be supplied with the new blade, when it becomes available.



Gyro Dozer

Key factors in the higher production of the Gyro Dozer are four penetrating teeth mounted on the cutting edge of the bulldozer blade. These teeth extend forward twenty inches in front of the cutting edge, and are used in ripping up stubborn material in order to more rapidly obtain full loading of the blade.

To aid in facilitating any desirable ripping angle of the teeth, the blade is capable of being tipped both forward and backward, and of being tilted 20-deg to either side. Tilting action is provided by two hydraulic cylinders mounted on the blade in place of the tilt braces. The blade is controlled by a No 44 front-mounted Hydraulic Control. Full positioning of the blade can be accomplished during operation by two levers located to the right of the operator. **Caterpillar Tractor Company, CE 3-139, Peoria, Ill.**

For Spanning Small Rivers

Pipe Arch Bridge

AN UNCONVENTIONAL "pipe arch" bridge, constructed like a dike with a succession of huge drainage culverts to carry water through its base, is proving to be a practical and economical structure for spanning small rivers and streams.

The design is basically the familiar culvert-under-a-road. It is multiplied into a row of 16 culverts laid side-by-side across a watercourse. The culverts serve a double purpose channeling the waterflow and supporting the earth fill on which the roadway is built.

A successful example of such a novel structure is Mill Village, Pa., where the corrugated steel sectional plate pipe arches were used in one of the first multiple pipe arch bridges in the East. Nearly a thousand pieces of sectional plate for the pipe arches were supplied for this bridge. Corrugated design of the sectional plates from which the pipe arches are made contributes to the bridge strength. According to the manufacturer corrugations add strength to the sectional plates without detracting from the flexibility and resistance to impact and vibration. **Republic Steel Corp., CE 3-139, 3100 East 45th Street, Cleveland 27, Ohio.**

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BLOOMSBURY, NEW JERSEY

EQUIPMENT MATERIALS and METHODS

(continued)

Batchmaster

A TOP PRODUCTION, PORTABLE aggregate plant is designed especially for highway contractors. This Heltzel Type 200 Batchmaster gives the contractor large capacity (to 200 plus tons), with high speed twin aggregate batchers for batch-truck batching and up to 8-yd batchers for truck mixer batching.

A smaller counterpart is the Type 100 Batchmaster that has a capacity of 100 tons. Both these plants are designed to go up fast, dismantle easily into sections that can be transported over existing highways without special permits. Both can carry the Heltzel 8-yd batcher, the industry's fastest and most accurate. These plants were designed, further, to be used in conjunction with the popular Heltzel E-3 Bulk Cement Plant. **Heltzel Steel Form & Iron Co., CE 3-140, Niles Road, S. E., Warren, Ohio.**

Huge Paper Bags

THE LARGEST PAPER BAG in the world, plus eight others of near record proportion was seen at the ARBA. Made to order, these, the first paper sacks ever to hold earthmovers, were designed to protect the machines from both the elements and prying eyes until they were put on display.

The largest of the bags measured 15 x 15 x 43 ft and weighed 113 lbs. The smallest of the nine was 8 x 8 x 14 ft. Because of their size and bulk, they had to be slipped over the machines after the units had been placed on flat cars. A big over-head crane handled the job of lifting the bags and lowering them into position. Three-quarters of a mile of 10-ft wide fiberglass reinforced laminated paper was used in making the nine bags. Altogether, the paper in them weighed more than a ton. **The Bemis Brothers Bag Company, CE 3-140, St. Louis, Mo.**

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ERECT IMAGE

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EQUIPMENT MATERIALS and METHODS

(continued)

Highway Safety Fence

THE HABITANT GLARE-GUARD safety fence gives three-way highway protection; (1) positive protection from the headlights of oncoming traffic lanes, (2) the combination of whole cedar logs and spaced steel pipe posts set in concrete resists car break-through into oncoming traffic lanes, (3) in addition, the fence cushions the blow with enough "give" to minimize the throw-back into the car's original lane of travel. Chain-reaction accidents caused by out-of-control return to former lane of travel are minimized.

Every picket is a full-round whole cedar log—drilled and assembled on horizontal steel pipe rails. Using the whole log prevents any splintering and gives nature's own resilient toughness of Northern White Cedar. Habitant owns and controls its own source of supply to insure finest quality material.

Upright galvanized steel posts, set in concrete are at intervals of 8-ft, or to your specifications. **Habitant Fence, Inc. Highway Division, CE 3-141, Bay City, Michigan.**

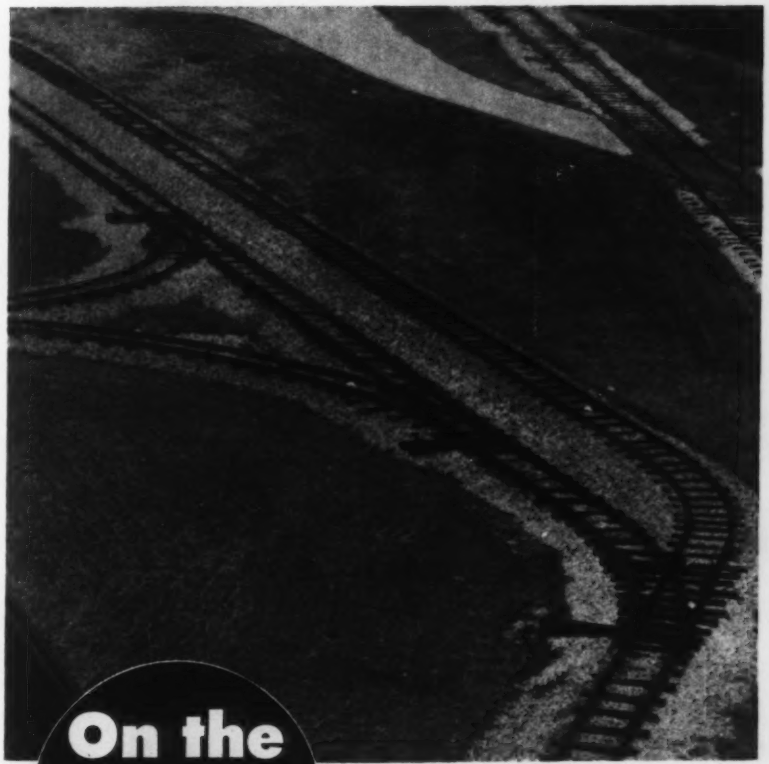
Model 1520

Roadmaster

THE MODEL 1520 ROADMASTER asphalt plant is specifically created to fill the user's greatest need; a complete, self-contained, fully automatic mobile asphalt plant that's ready to operate in minutes, right at the jobsite, and delivering tonnages formerly restricted only to a larger and more costly stationary hot-mix plants.

It is a completely new machine, delivering hot asphalt mix at the rate of 15 to 20 tons per hour, to meet your own specifications. And yet, even with this capacity, is self contained and so completely mobile, that it can be towed and set into position as a stationary plant or moved to a new location by one of your dump trucks already on the job.

(Continued on page 142)



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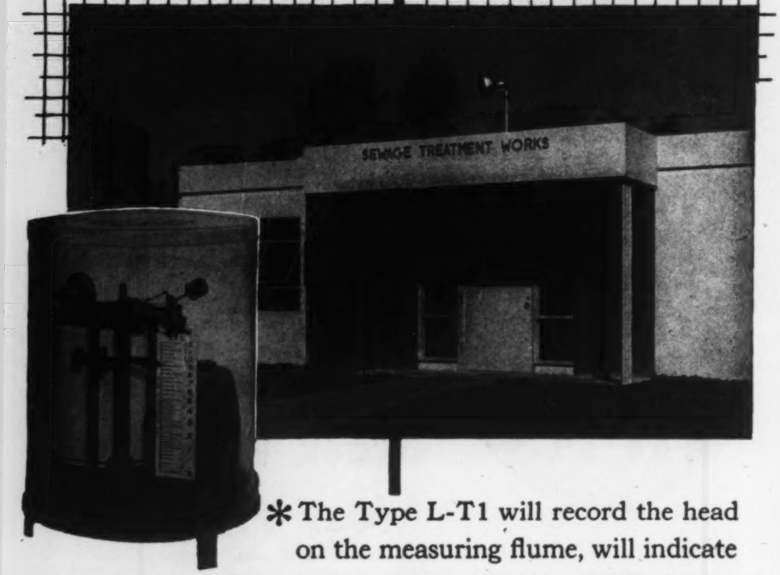

PROBLEM:
To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:
Stevens Type L-T1 Recorder*

* The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

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144 pages of technical data on recorder installations...plus a wealth of hydraulic tables and conversion tables. Send $1.00 (No C.O.D.'s)

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EQUIPMENT MATERIALS and METHODS

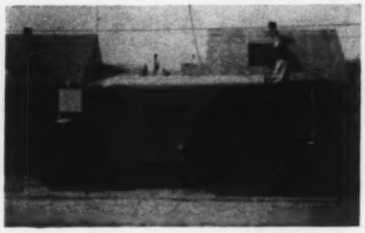
(continued)

Every economy angle has been considered. Twin aggregate hoppers hold over a cubic yard of material each, and with the reciprocating plate feeder, the coarse and fine aggregates are fed accurately into the elevator boot. After the aggregate passes through the rotary dryer, it enters a weight-controlled aggregate batcher, and in turn is discharged simultaneously with a required proportion of hot asphalt into the twin-shaft pugmill. Four low-pressure oil burners supply heat for the rotary dryer and the 400-gal asphalt tank. It is available with gasoline or diesel engine and mounted on six pneumatic tires with stabilizer jacks or on skids as a stationary installation. **Wylie Mfg. Co., CE 3-141 and 142, P. O. Box 7086, Oklahoma City, Okla.**

3-Wheel Roller Line

A COMPLETELY NEW LINE of 3-wheel rollers with torque converter, two-speed transmission, and several features never before offered on 3-wheel units, were shown.

Five basic models are offered for all general purpose, finishing and variable-weight compression jobs. The 10, 12, and 14-ton models can be supplied with either standard-sized cast rolls for general purpose compaction or wider cast rolls for finishing work. For variable compression, Huber-Warco offers the 10-12 and 12-14 ton models with fabricated, water-tight rolls.



Features 2-Speed Transmission

All models—both standard and variable weight—feature Huber-Warco's combination of a torque converter and two-speed transmission. In addition to all the well-known advantages of a torque converter, this combination also provides many bonus benefits such as more economical operation, longer parts life, and fast steering at all roller speeds.

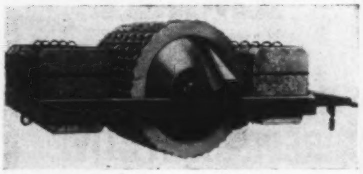
A tail shaft governor teams up with the torque converter and two-speed transmission to bring new ease of operation. Within close limits, it automatically maintains the rolling speed set by the operator, regardless of grade. **Huber-Warco Company, CE 3-142, Marion, Ohio.**

EQUIPMENT MATERIALS and METHODS

(continued)

Grid Roller

A FEATURE DISPLAY AT THE Road Show, the Grid roller is unique in that it conforms to neither the conventional sheepsfoot roller nor with the smooth roller. Actually, it embodies some principles common to both of these rollers but, because of its distinctive design, it is able to perform more varied types of work. The machine consists of two drums mounted on individual axles, each drum 32-in. wide having an outside diameter of 67-in. The drums are fabricated from cast-steel sections; these sections giving the appearance of interwoven bars with square open spaces between. Where these bars overlap a high point is created which is capable of exerting great pressure on the material being rolled.



Unique Design

The two drums are mounted on a frame which contains provision for supporting a number of individual concrete ballast weights. An adjustable tongue is also provided which allows the roller to be towed about a foot off center to either side. This feature is important for such applications as rolling embankment shoulders, against curbs, or other confining structures. **Hyster Co., CE 3-143 2902 N. E. Clackamas St., Portland 8, Ore.**

Drills And Compressors

INGERSOLL-RAND COMPANY displayed its complete line of equipment of major importance to the construction industry. The Rock Drill portion of the exhibit included the Crawl-ir drill, the Drillmaster, a size FM-4 wagon drill and hydraulically-operated booms. The Crawl-ir drill is a completely new crawler-mounted drill with hydraulic-operated boom, and powered dump and swing. The Drillmaster, well-known super drill rig, is completely self-powered by its own 600 cfm portable compressor. This unit may be equipped with either rotary or percussion drills for holes up to 6½-in. diameter.

The line of GYRO-FLO rotary compressors was represented by the 85, 315 and 900 cfm machines, from their complete line. **Ingersoll-Rand Co., CE 3-143, 11 Broadway, N. Y. 4, N. Y.**

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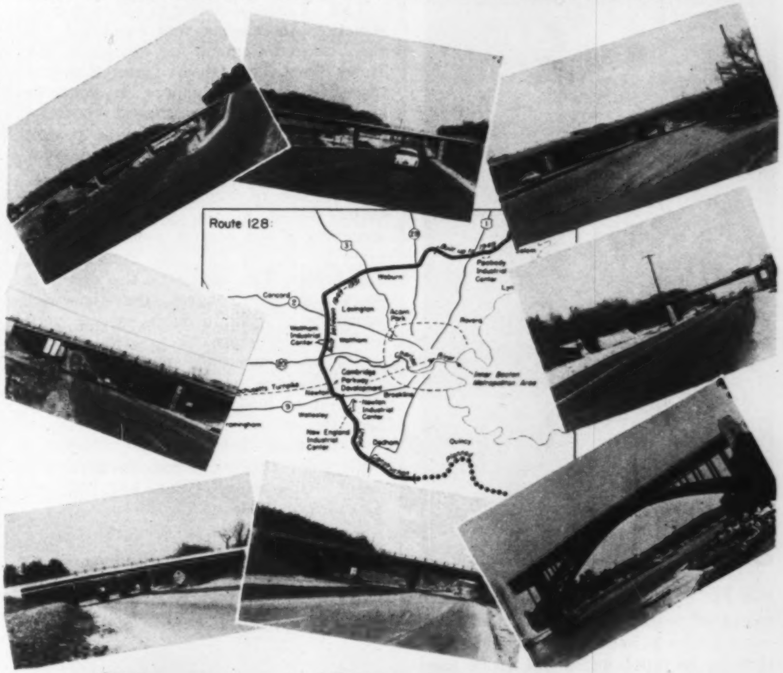
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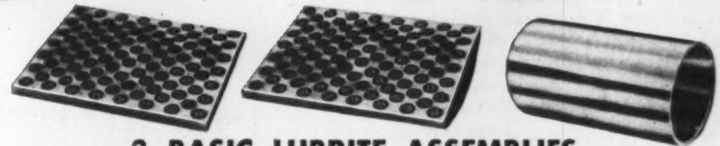
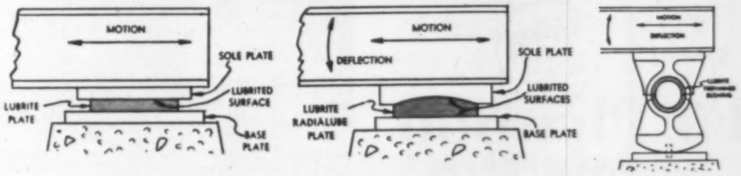
Newton Industrial Center
Wellesley
New England Industrial Center
Dedham
Quincy
Inner Boston Metropolitan Area



3 BASIC LUBRITE ASSEMBLIES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LUBRITED SURFACE
LUBRITE PLATE
BASE PLATE
MOTION
DEFLECTION
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LUBRITE RADIALUBE PLATE
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Lubrite offers many distinct advantages to any bridge, overpass, building, or other construction where the problems of expansion, contraction and/or rotation of a structural member are factors in the design. Specifically, Lubrite offers simplified design, low known co-efficient of friction, reduction in construction costs and the virtual elimination of maintenance in bearing assemblies. Lubrite's fifty years of successes in all types of installations are your assurance of better results and longer life.

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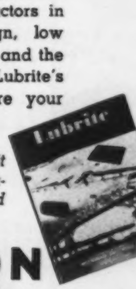

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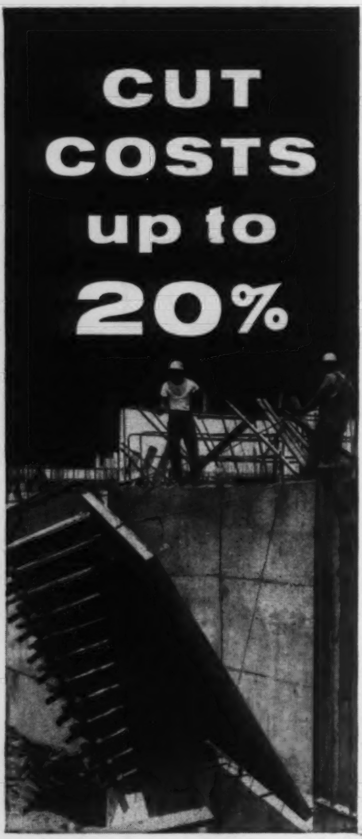

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EQUIPMENT MATERIALS and METHODS

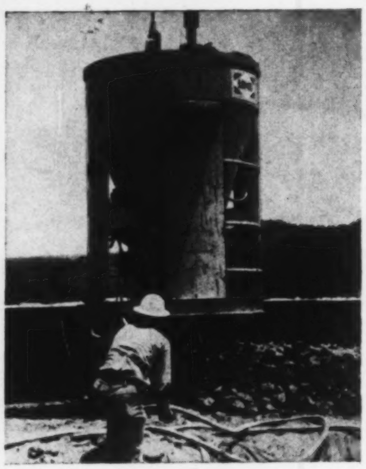
(continued)

New Techniques

The newest and best in concrete construction techniques was exhibited by the Portland Cement Association at the Road Show. The exhibit featured much-discussed recent advances in concrete structures such as prestressed concrete, as well as the first heavy-duty paving jobs inaugurating the nation's 13-year highway program.

A feature of the display was a specially edited motion picture on construction of the biggest prestressed concrete job to date, the Lake Ponchartrain, La., bridge. The film, tells the dramatic story of the longest over-the-water structure ever built, from casting yard to finished structure.

Several concrete pavement jobs awarded since passage of the Federal-Aid Act of 1956, and already completed sections of the 41,000-mile Interstate System were described and illustrated with color transparencies. **Portland Cement Association, CE 3-144, 33 W. Grand Ave., Chicago 10, Ill.**



Hydraulic Bucket

Shown for the first time, the new CHC4 hydraulic concrete bucket handles 4-cu yds. It is the first concrete bucket equipped with self-contained power for operating the discharge gates.

Eliminating the use of an air hose, it also eliminates having compressed air available at the site during placement of concrete. Instead, the weight of the bucket generates the needed pressure for operating the clam discharge gates. The bucket hangs from its pendant on two hydraulic cylinders or accumulators. Operating a lever on the hydraulic valve

(Continued on page 145)

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permits the bucket's weight to transmit pressure to the gate cylinders which operate the gates.

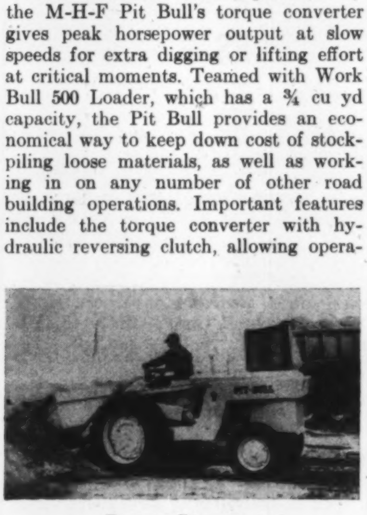
Sufficient oil is stored in the hydraulic system for emptying a portion of the bucket's load, closing the gates and then reopening them for a second pouring. When the bucket is set down, the spring-loaded pendant drops, reversing oil flow in the hydraulic system. This automatically recharges the bucket for power operation.

Compared with air-operated type buckets currently available, the open and close time of the new hydraulic bucket's clam discharge gates is between two and three times as fast.

The four-way operating valve is spring-loaded to keep the gates closed and will also allow partial gate opening for dribbling operations. **Blaw-Knox Co., CE 3-144 and 145, 300 Sixth Avenue, Pittsburgh, Pa.**

Pit Bull

More crowding power, provided by the M-H-F Pit Bull's torque converter gives peak horsepower output at slow speeds for extra digging or lifting effort at critical moments. Teamed with Work Bull 500 Loader, which has a ¾ cu yd capacity, the Pit Bull provides an economical way to keep down cost of stockpiling loose materials, as well as working in on any number of other road building operations. Important features include the torque converter with hydraulic reversing clutch, allowing operator to reverse directions without gear shifting, five forward and five reverse speeds, unobstructed visibility, and a roomy comfortable driver's platform (with optional cab mounting). Gas or diesel power plants are purchaser's choice.



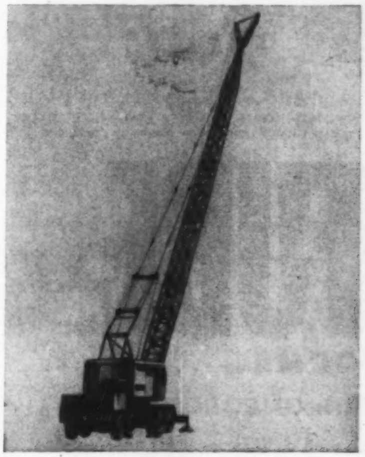
Torque Converter

A full line of five versatile Work Bull wheel tractors for use on road building assignments as primary equipment, back-up machines and utility or clean-up tools, is available with 20-power matched attachments, and is the first such "package" available from a single source. **Massey-Harris-Ferguson, Inc., CE 3-145, Racine, Wisconsin.**

45 Ton Truck Crane

The first 45 ton truck crane expressly designed for over-the-highway use, P&H's model 575-TC, brings new mobility and flexibility to truck cranes of the highest capacity built. This new truck crane has a significantly greater lifting capacity than comparably rated machines, since its 45 ton rating is based at 15 ft radius rather than the usual 12 ft. This is important as working radii are almost always beyond 12 ft. The model 575-TC has demonstrated its ability to lift, unassisted, booms up to 170 ft long.

Instead of following the usual practice of building a special truck crane requiring extensive dismantling to meet axle limitations, Harnischfeger has designed and built an entirely new carrier to meet state codes by distributing weight over a greater number of axles. **Harnischfeger Corp., CE 3-145, 4400 W. National Avenue, Milwaukee, Wisc.**



Hydra-Hammer

Larger engine and heavier hammer on the new Model SPHH-1000 Ottawa Hydra-Hammer effect greater production on all pavement breaking, cutting, and backfill tamping jobs. This new model includes many features (such as the traverse tower arrangement, hydraulically controlled lay-down, engine cover, rear fenders, adjustable seat, flange type tools, and combined power brake and clutch control) which are also standard on all other Ottawa Hydra-Hammers.

The 7500-ft lb blow developed by the Model SPHH-1000 Hydra-Hammer is actually controlled so that the maximum blow, or a minimum blow as little as 100-ft lbs, can be used at the operator's will. **Ottawa Steel Division, L. A. Young Spring & Wire Corp., CE 3-145, P. O. Box 39, Ottawa, Kansas.**

Special Hoists
FROM STANDARD PARTS
One of Eight Special Electric Incline Hoists with 36" diameter x 26" face drums, built for unbalanced duty of 1,500 lbs. at 200 FPM

• By modifying and re-combining our standard parts, Superior-Lidgerwood-Mundy can engineer hoists to meet your specific requirements at the lowest possible cost.

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SONOTUBES®
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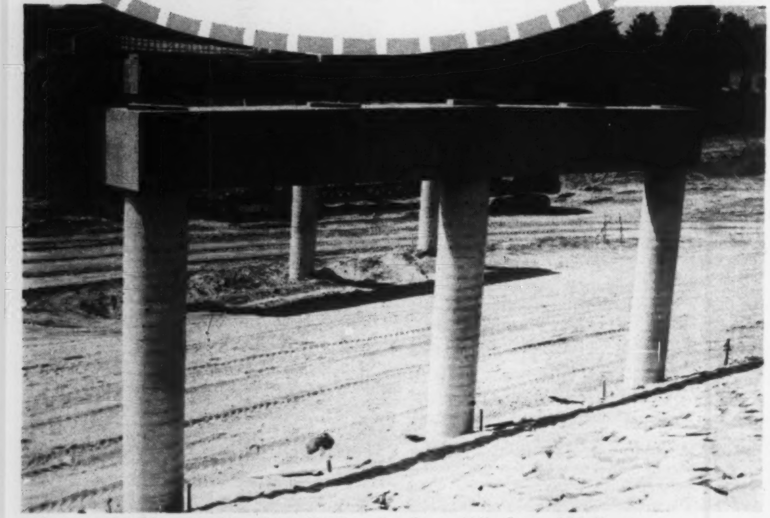
piers for overpass bridge!



Overpass for side roads, New Hampshire Turnpike, Dover, N.H., State of N. H., owner. Landers and Griffin, contractors. Hayden, Harding & Buchanan, engineers. Photo by Zambello.

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for round columns of concrete

Both 36 and 30 inch SONOTUBES were used as formwork for the round concrete piers of this highway overpass bridge on the New Hampshire Turnpike. Forming for caps tie-in easily with the fibre forms of the supporting piers

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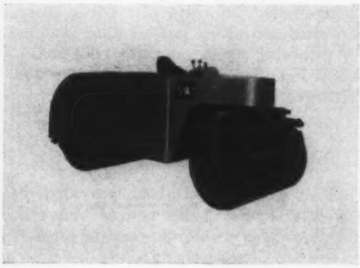
EQUIPMENT MATERIALS and METHODS

(continued)

Steel Wheel Rollers

Two NEW DESIGNS IN Tandem steel rollers were shown for the first time. The two models, rated at 5 to 8 and 8 to 12 tons respectively, have several new engineered features that emphasize ease of operation and control flexibility. A specially-designed transmission on each unit permits three speeds in both forward and reverse movement—and these speeds are controlled by a single lever. No shifting or clutching are required. New hydraulic power steering permits smooth, effortless handling, minimizing operator fatigue. Provision for water ballast in both front and rear rollers offers wide variation in weight adjustment to fit specific needs. Overall design is extremely low, for greatly improved visibility front and rear, with low center of gravity for improved stability. Gasoline engines are standard, rated 65 and 73 hp, with diesel available on special order. **Seaman-Andwall Corp., CE 3-146, Milwaukee 1, Wisc.**



Newly Designed

New Models

EIGHT CUMMINS DIESELS, including three new models were shown at the Road Show.

The new models are: (1) an eight cylinder, vee-type 5 x 5, 375 horsepower naturally aspirated engine with a 783 cu in. displacement; (2) a four cylinder 4-1/8 x 5, 60 hp, naturally aspirated engine of the Cummins "J" series, with a displacement of 267-cu in.; and (3) a 375 hp NFT-6 Cummins Turbodiesel engine, with a 5-1/8 x 6 bore and stroke and 743-cu in. displacement.

Cut-a-way models (engine with windows) were featured at the display which included the 335 hp NRTO-6 and the 600 hp VT-12 Cummins Turbodiesel engines. All the Turbodiesel engines feature turbo-superchargers designed and manufactured by Cummins. **Cummins Engine Company, Inc., CE 3-146, Columbus, Indiana.**

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Make your money earn real profits for you by investing in EFCO Steel Forms for your concrete construction. Original cost is low. Lifetime steel faces should never need replacing.

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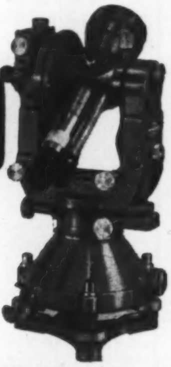
Other offices are in St. Louis, Mo.; Kansas City, Mo.; Lincoln, Nebr.; Minneapolis, Minn.; Ft. Wayne, Ind.; Milwaukee, Wisc.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Metuchen, N. J.; Rochester, N. Y.; Springfield, Mass.; Waltham, Mass.; New York, N. Y.; Washington, D. C.; Decatur, Ga.; Charlotte, N. C.; Dallas, Texas; Tulsa, Okla.; Houston, Texas; Los Angeles, Cal.; Oakland, Cal.; Denver, Colo.

WILD HEERBRUGG

T-3 Precision Theodolite



A WILD instrument designed for highest accuracy, time-saving conveniences, and a remarkable work potential

The Wild T-3 Precision Theodolite is the supreme instrument in its class . . . for accuracy . . . versatility . . . and for its proved reliability in virtually all conditions of weather and climate.

The T-3 is an ultimate instrument for Geodesy and for precision triangulations. It has a distinguished record in triangulating the longest bridge spans in the world.

NOTABLE FEATURES OF THE WILD T-3

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- **No eccentricity error.**
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EQUIPMENT MATERIALS and METHODS

(continued)

Tractor-Excavator

The excellent performance of the Eimco 105 Tractor-Excavator can be attributed to its superior design, materials and construction. Exclusive features of the tractor include its all alloy-steel construction—a standard feature of all machines at no extra cost. All rollers and idlers are one piece cast alloy steel with Timken roller bearings fitted in separate alloy steel bearing cages to assure proper alignment and easy replacement.

The master clutch has been eliminated and every machine uses a torque-converter drive. Eimcos are the first tractors to use a power shift transmission. The Unidrive transmission contains all necessary gearing for forward and backward motion, gear changing and speed changing with clutches that never need adjustment. Independently controlled tracks permit one track to run forward while the other is running reverse to produce a spin turn.

The excavator attachment is mounted directly on the extra heavy frame of the tractor allowing the track to oscillate even with the loading attachment in place. **The Eimco Corporation, CE 3-147, 634 S. Fourth St., Salt Lake City, Utah.**

New Protective Features

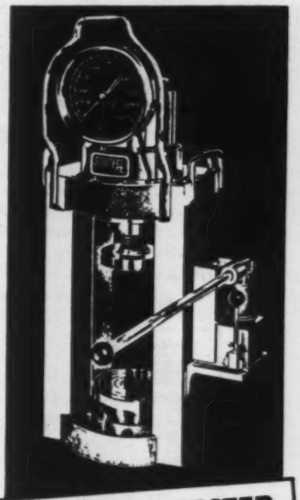
Several new protective features have been added to the Wisconsin Engines that power Clipper's 36 hp and 25 hp Concrete Saws.

Both the C-360 and the C-250 Clipper Concrete Saw Models are now equipped with exhaust valves and inserts that are faced with Stellite, an extra hard metal, and positive Valve Rotators which cause the valves to turn approximately 6-deg each time they are opened. This rotating action greatly extends the life of the valve for several reasons.

Valve rotation helps to maintain a lower, more uniform temperature all around the valve, thus minimizing burning, warping, and distortion. In addition, deposits on the valve face are removed and the rotating valve stem is kept cleaner and more uniformly lubricated. This in turn greatly reduces the possibility of the valve sticking.

Stellite faced exhaust valves and inserts with Positive Valve Rotators is one of the greatest advances in engine development in recent years and are now offered by Clipper with no increase in cost. Research reports from the Ethyl Corporation indicate this feature alone will increase valve life as much as 500 per cent. **Clipper Manufacturing Co., CE 3-147, 2800 Warwick, Kansas City, Missouri.**

JOB-SITE TESTING SAVES MONEY



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A Compact, Portable and entirely Self-Contained unit. Easily operated by hand, the New CT-711 Concrete Tester is ideal for accurate and quick concrete testing.

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CAPACITY TO 200,000 POUNDS

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A Lightweight, Self-Contained and Accurate unit that provides a positive method for determining the In-Place Density of Soils and Construction Fill Materials.

Excellent for Tests in Embankment Control and Subgrade Compaction

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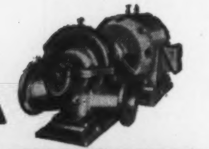

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The engineer-favor accorded "PUMPS by Aurora" rests squarely upon performance satisfaction. Why not let Aurora precision and quality serve your requirements, too?

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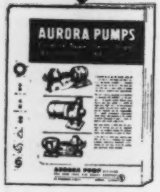

AURORA APCO *Turbine-Type* PUMPS

are available in SINGLE STAGE • TWO STAGE • FOUR STAGE • WATER JACKETED • STAINLESS STEEL or SPECIAL METALS for "1001" DUTIES.

AURORA *Centrifugal* PUMPS

are available in SINGLE and TWO STAGE HORIZONTALLY SPLIT CASE • SIDE SUCTION • VERTICAL • NON CLOG • SUMP • MIXED FLOW • SPECIAL DESIGN ETC.

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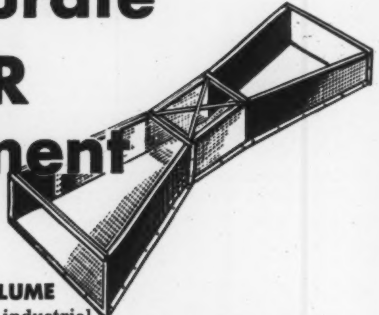
98% Accurate WATER measurement

regardless of velocity



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For open channels in industrial plants, waterworks, irrigation systems, and sewage disposal plants. Easy to read. Self-cleaning. Low head loss. Galvanized steel. Throat widths 3" to 10'.

AUTOMATIC CONTROL GATES REGULATE FLOW, AND WATER LEVELS

. . . regardless of water supply variation.

Ends need for 24-hour supervision—prevents water waste, field flooding, overflow. No floats, sheaves, motors or cables.

STEEL FABRICATION SPECIALISTS since 1878. Storage and pressure tanks, filter plant piping and industrial equipment fabricated from mild steel, stainless, monel, and non-ferrous metals to your specifications.

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TP 7-7

EQUIPMENT MATERIALS and METHODS

(continued)

Form-Crete Forms

Materials shortages and increasing construction costs have resulted in a tremendous demand for prestressed and precast concrete products. Engineers find the answer to present day construction problems in reinforced, precast and prestressed concrete.

From the standpoint of safety, fire and bomb resistance, economy in original and erection costs, this new building medium gives you the ultimate in better construction at lower cost. The problem of mass production of uniformly accurate prestressed concrete castings has been solved through the development of the Form-Crete system. The concrete products manufacturing industry is offered a most varied and multiple-use assortment of Form-Crete steel forms that will fit into any existing plant with a minimum of alteration and installation costs, and maximum interchangeability throughout the entire size range of square piling and beam shapes.

Designed for use on a flat casting bed the mounting holes on all forms are spaced to fit the imbedded inserts in the casting bed so that the same end abutments may be used for casting the different concrete shapes. This mounting uniformity also permits the use of two or more different forms for casting different shapes simultaneously on the same flat bed. **Food Machinery And Chemical Corp., Florida Division, CE 3-148, Lakeland, Florida.**

Highway Signs

Porcelainized aluminum extrusions and raised reflective lettering have been combined for the first time to double the life expectancy of highway signs on the new Kansas Turnpike.

Ordinary highway signs must be refinished or replaced every five to eight years. These signs, installed by Federal Sign and Signal Corporation, pioneer designer, engineer and manufacturer of electrical outdoor displays, street markers and highway signs, are expected to last for as long as 15 years without recoating. The turnpike sign program involves $400,000 worth of highway signs and markers.

Approximately 1,500 of the dark green porcelain signs will guide motorists along the 236-mile Kansas Turnpike, which will form a major link in the proposed Maine to California turnpike system. The Turnpike extends from Kansas City, south through Topeka and Wichita, to the Oklahoma border. **Federal Sign and Signal Corp., CE 3-148, 8700 South State St., Chicago 19, Ill.**

EQUIPMENT, MATERIALS and METHODS

(continued)

Muffle Cover

THE NOISY BUT NECESSARY air hammer is getting the silent treatment. Engineers have developed a sound-squelching Muffle Cover for the Model 25 paving breaker that attracted much trade interest as a special feature of Thor's exhibit.

Company engineers said that the new Muffle Cover reduces air hammer noise intensity up to 55 per cent. The cover was readied for field testing and introduction to the trade after months of laboratory research and testing with complex noise measurement instruments.

The new accessory is a thick, double jacket of sound-proofing materials that zips snuggly around the paving breaker. It effectively reduces the exhaust noise and the sharp staccato clang of the piston hammer hitting the tappet. The "soft thud" of the breaker's steel striking the material being worked is all that remains, the Thor engineers said.

The inner and outer jackets, both zippered for easy attachment and removal, are not sold separately. **Thor Power Tool Company, CE 3-149, 175 State St., Aurora, Ill.**

Fork Lift Unit

A NEW POWERED FORK LIFT unit engineered to handle building construction materials under the conditions encountered on all building construction jobs has been developed. The unit is especially adapted to handling packaged brick and will unload brick from trucks, pick up at stockpile, carry load over rough ground, up 20 per cent grades, on building hoists, through narrow or low doorways and place the load on the scaffold.

The Prime-Mover L-10 Fork Lift easily handles two 100-brick packages or equivalent 1000-lb load and lifts the load to a height of 6-ft, 6-in. in 6½-sec. The entire unit is only 31½-in. wide and the lift mast tilts back to pass under a 6-ft, 8-in. door.

For job-wide materials handling, the fork lift is unit-designed so that it can be quickly removed from the chassis and replaced with the standard Prime-Mover 10-cu ft dump bucket or two sizes of flatbeds for hauling concrete or mortar, and block, forms, equipment and lumber. **The Prime-Mover Co., CE 3-149, Muscatine, Iowa.**

Top Speed Performance

AN IMPORTANT FACTOR IN the ability of this rugged built unit to prevent cracking and checking in plastic concrete is its speed and efficient performance. Only the Rex Curing Machine can step up its operating speed to five times normal speed and actually overtake the paver. You have complete flexibility to adjust speed to suit all types of weather and temperature conditions.

The great feature that helps keep the machine way ahead is the exclusive self-priming, positive displacement pump. Unlike the commonly used piston-type pump, there is completely uniform flow. It easily handles solids in suspension and passes particles without clogging. No valves, cylinders or pistons to cause excessive wear, a big advantage with abrasive fluids. You get a smooth, even material flow without pulsation.

Spray head is driven by a hydraulic V-belt drive which transmits power to roller chain, which carries the spray head across the entire width of the machine. **Chain Belt Company, CE 3-149, North Main Street, Niles, Ohio.**

10 DAY FREE TRIAL

. . . of a Warren-Knight Transit!

Try a Warren-Knight Transit on your own work FREE for 10 days! Then you'll see for yourself how special advantages of these famous instruments save time and money. Model 2cF for instance, has disappearing stadia, graduations differentiated by BOTH size and slant, and replaceable leveling screws. To obtain full information on many other extra advantages, write for FREE information CE-73 with full details

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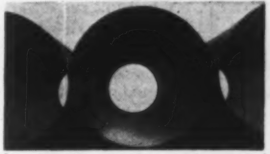

Provides mirror-like surface with a tight bond

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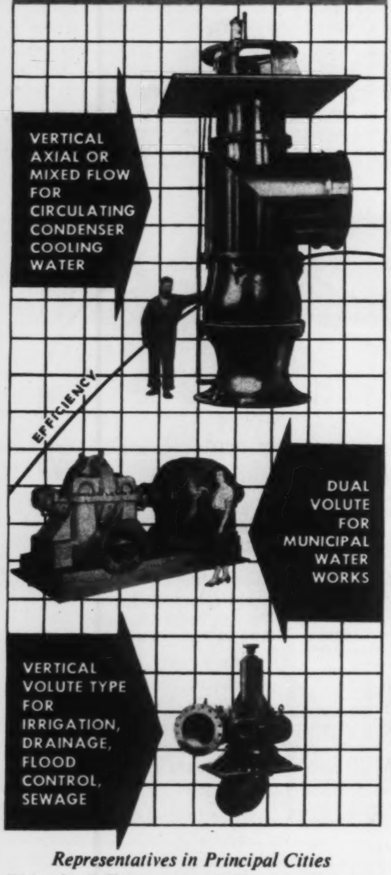
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EQUIPMENT MATERIALS and METHODS

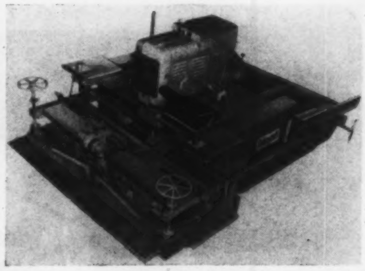
(continued)

New Bituminous Paver

THE RESULT OF more than seven years of market study, designing and field testing embodies a completely new concept in bituminous paving, according to the manufacturer.

The high speed with which the Bituminous Paver works and still meets asphaltic concrete paving specifications has caused a great deal of favorable comment. This is made possible by the most important single feature of the new paver, a new principle of paving by use of an electrically-vibrated screed which "irons" the bituminous material into a smooth, uniform, high-density mat.

The 24-in. wide channel-shaped screed is made of special ½-in. steel plate which resists abrasive wear and distortion. It is equipped with two screw adjustments with vernier type gauges for controlling mat thickness. Separate front and rear crown adjustments can set the screed to pave from a ¾-in. negative crown to a 3-in. positive crown. **Iowa Mfg. Co., CE 3-150, Cedar Rapids, Iowa.**

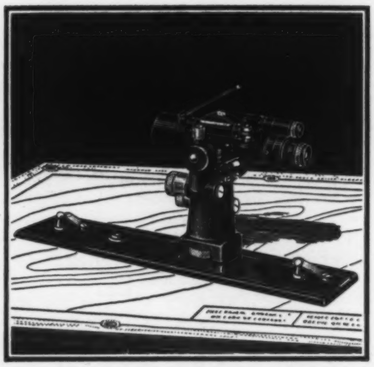


Special Screed

Graders & Cranes

A COMPLETE LINE OF graders, rollers, sweepers and hydraulic cranes were shown by Austin-Western in Chicago. Their Power Graders are built to give 30 percent more power at the blade than ordinary graders. Extra features built into these graders include: all-wheel drive, all-wheel steer, controlled traction, precision side-shift, high-lift blade (90 deg right or left), extreme blade reach, completely reversible blade, finger-tip hydraulic controls.

The most versatile "arms" in industry, their Hydraulic Cranes, combine pick-up, carrying and placement capabilities with the best features of crawler, truck and shop cranes. All movements of the live boom are actuated by fast, smooth hydraulic power. Two or more movements of the boom and cable are possible while the tractor is moving. **Austin-Western Works, Baldwin-Lima-Hamilton, CE 3-150, Aurora, Ill.**



WATTS MICROPTIC ALIDADES FINEST IN THE FIELD

For swift accurate field mapping and surveying, leading surveyors rely on the Watts Microptic Alidade. The Watts Alidade is highly accurate, compact, light weight, versatile and dependable. See the advanced-design Watts Microptic Alidade with exclusive pillar levelling at your nearby Dietzgen Dealer. Made by Hilger & Watts, Ltd., London; sold and serviced in the United States by the Eugene Dietzgen Co.

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TIDE GATES

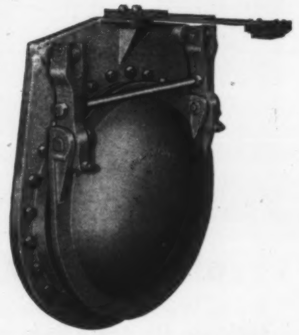

Figure B-175. Type M-R Gates designed especially for application to centrifugal pump discharge lines. A rubber seating ring is inserted in the seat to absorb the slap which occurs when pumps stop. A flexible bar connection is arranged between the hinge links to provide a stop for the gate shutter to prevent the outer edge of the shutter from tipping downwardly when flow abruptly ceases. Smaller sizes of gate are provided with a bumper arrangement to prevent the shutter being forced too widely open when flow starts.

Ask for Bulletin 73A

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

EQUIPMENT MATERIALS and METHODS

(continued)

Soil Compaction Machine

A NEW MECHANICAL SOIL compactor eliminates the tedious hand compaction process and produces uniform results with a considerable saving of time. The compaction test is performed to determine a soils moisture-density relationship and the maximum density to which a construction fill or subgrade material should be compacted.

The compactor is easily adaptable for the interchange of the standard 5.5-lb (12-in. drop) and modified 10-lb (18-in. drop) hammers for performing compaction tests in accordance with AASHO and ASTM specifications. The machine may also be adapted for compacting in a 6-in. diameter California Bearing Ratio mold by using a specially designed pie-shaped foot hammer.

The tester is powered by an electric gear transmission drive which operates the compacting mechanism at a rapid rate. The drop hammers are automatically picked up after each contact with the soil and lifted to the exact 12 or 18-in. height for the next drop. A counter registers the number of blows per compaction layer and can be pre-set to stop the hammer operation at a specified number of blows. The soil mold is automatically indexed to a new position after each blow of the compaction hammer. **Soiltest, Inc., CE 3-151, 4711 W. North Avenue, Chicago 39, Ill.**

Curing Blankets

NEW BLEACHED WHITE Sisalkraft means time and labor-saving advantages over all other curing methods. Actual on-the-job testing has shown that, with ordinary care and handling, it is possible to obtain up to 15 re-uses. The re-use performance of Sisalkraft brings your actual curing material costs down to less than two cents per sq yd.

For further economy, bleached white Sisalkraft blankets are available in tailor-made widths to fit the slab and/or in lengths meeting transverse joint spacing to facilitate sawing.

Even at this low cost, the Sisalkraft Curing Method completely fulfills the requirements of the specification. The waterproof paper method of curing is included as a standard alternate in the curing specifications of 41 state highway departments, as well as federal, county and city engineers. The top turnpike authorities, such as Pennsylvania, Ohio, Kentucky, Texas and Oklahoma Turnpikes, New York Thruway and the Illinois Toll Road have also specified this method. **American Sisalkraft Corp., CE 3-151, 55 Starkey Ave., Attleboro, Mass.**

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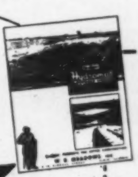
SEALTIGHT Hydromat ASPHALT LINERS

Pre-fabricated "HYDROMAT" Asphalt Liners provide the ideal liner for all domestic, industrial and recreational facilities where the containment of water, wastes, sludges, brines, etc. demand a very efficient, economical and impervious lining material. "HYDROMAT" is quickly and easily installed as a monolithic liner with mechanically sealed joints . . will expand and contract with soil movements without rupturing or breaking the seal. Installed over (exposed) or under earth, concrete, gunite, steel or other materials... provides the practical answer to the problem of re-lining old, cracked concrete or gunite linings. "HYDROMAT" may be safely used for the containment of potable water in clear well construction and its ruggedness and durability permit its use as a fully exposed lining in large reservoirs to depths exceeding 50 feet. "HYDROMAT" is available in three thicknesses, ½", ¼" and 5/32", in 4' widths and lengths up to 15' . . . longer lengths available on special request.

For complete installation and technical data write today for your copy of the "HYDROMAT MANUAL".



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SHEAR
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The Acker Vane Shear Test Kit has everything needed to obtain fast, accurate, "in-place" shear readings to depths of 100 feet!

It's easy to use and provides accurate soils information at low cost! For ease in carrying, the entire set of tools are packaged in a handy steel kit.

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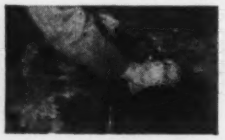
Assemble the Vane to the Rod!

Insert in Casing and Apply Pressure to the Torque Wrench!



Consult the Torque Chart for Accurate Reading!

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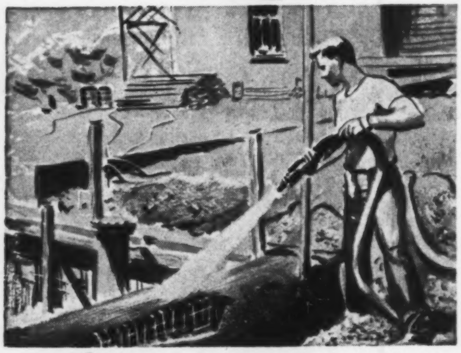

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Literature Available

Horizontal Shoring—Newly published is an 8-page catalog on the subject of Spanall, registered trade name of the prestressed all-metal horizontal shoring, now available throughout the United States, Canada and Latin America, for all types of beam and slab concrete floor forms. The catalog contains descriptions of the products including all essential engineering and application data. Detailed isometric drawings and two pages of photographs illustrate typical installation techniques. A valuable feature on the back cover of the catalog is the pair of reference charts which help the builder quickly determine the most economical combinations of Spanall sections to attain various span lengths, and the correct relationships between slab thickness, weight-of-slab, length-of-span and spacing between supports. **Spanall of the Americas Inc., CE 3-152, 787 United Nations Plaza, New York 17, N. Y.**

Hydrological Instruments—A new bulletin 700 describing operation and features of current meters, water level recorders, hook gages, rain gages and wind instruments, has just been published. It contains information on models of the Gurley Current Meter (Price Pattern) and various outfits in which it is available, including suspension cables and wading rod sets. Included in this section is a model especially adapted for salt water use, and a pygmy model for measuring flow of water in shallow streams. Drawings show customary methods of supporting meters in the water, and details are given for assembling both suspension cables and wading rods. Other sections describe the use of Gurley Graphic Water Level Recorders, including range and time scales. **W. & L. E. Gurley, Industrial Div., CE 3-152, Troy, N. Y.**

Precision Instruments—A new four-color catalog containing information about the company's entire line of precision instruments will soon be available. The catalog is unique in the field because of its completely modern format, typography and the fact that it is four-color throughout. In addition to pictorial and descriptive information on the company's entire line of instruments new products are listed. **David White Instrument Co., CE 3-152, 2501 N. 19th St., Milwaukee, Wisconsin.**

Streamliner—A four page leaflet in color is offered describing the Ozalid streamliner 200, the first full-width whiteprinter for less than a thousand dollars. Ideal for short runs and "stand-by" printmaking. **Ozalid, CE 3-152, Johnson City, N. Y.**

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Structural Steel
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Films Available

"All Holes Barred"—a new 20-min color movie showing the correct application of "Scotchrap" vinyl pipe insulating tape for corrosion prevention has been announced. Prepared as a training film for free showing to workmen using vinyl pipe insulating tape, the new film is available through 3M branch offices and salesmen. The color and sound movie presents corrosion principles in a very elementary manner with cartoon characters dramatizing the effect of electrolysis on unprotected and faultily protected pipe. Step-by-step sequences show proven methods of insulating couplings, street "T" fittings, weld joints and elbows as well as straight sections of pipe. **Minnesota Mining and Manufacturing Co., CE 3-153, 900 Fauquier Street, St. Paul 6, Minn.**

Asphalt Films—Several films are available on a loan basis or may be purchased. "Asphalt Through The Ages" is a documentary film that traces history of asphalt from ancient times to the present. "Two Roads" the story of an asphalt road and a concrete road. Other films showing the construction of the Garden State Parkway, N. J. Turnpike and the Turner Turnpike are obtainable. **Asphalt Institute, CE 3-153, College Park, Md.**

"Portrait Of The Earth"—A 23½-min color sound 16-mm film on aerial photography, photogrammetric methods, mapping procedures and airborne geophysics is made available at no charge. When requesting, please suggest several alternate dates for showing and the film will be made available. The film covers high and low altitude aerial photography procedure, aerial cameras, the use of Kelsh, Multilex and hold equipment, indexing, and general mapping methods. On the lighter side are included beautiful color shots and aircraft operations over the Colorado Plateau, California and the South American Andes. **Hycon Aerial Surveys, Inc., CE 3-153, 1020-1030 S. Arroyo Parkway, Pasadena 2, California.**

"The Eighth Sea"—The dramatic story of the planning and development of the huge St. Lawrence Seaway, a project rivaling that of the Suez Canal or Panama Canal, is told in straightforward documentary style in a new color and sound film, "The Eighth Sea", presented by Caterpillar Tractor Co. Walter Cronkite, popular American television commentator, narrates the film, giving each detail of the giant undertaking in a factual and logical explanation of the hopes and dreams behind this international development. **Advertising Division, Caterpillar Tractor Co., CE 3-153, Peoria, Ill.**

BOILER ROOM FLOORS
MUST STAY
SAFE, CLEAN

Ashes, coal and other substances under foot often make solid floors in boiler rooms unsafe.

Such hazardous materials cannot accumulate on a floor made of Irving open steel grating. Debris falls right through, making floors always clean. Dangerous fumes can escape through open grating. Floors made of Irving Grating are clean, safe at all times . . . no ankle turning, tripping, slipping, hot foots. It is fireproof, self-ventilating.

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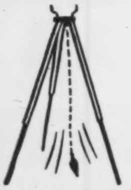
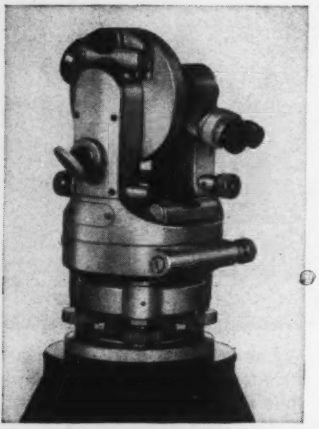
SURVEYING NEWS

NEW THEODOLITE SETS UP QUICKLY, EVEN IN THE WIND



Has this been your problem? Now—old-type mechanical plumb-bob replaced by can't-miss optical principle



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- Reads direct to 1 min. with no matching of lines—no parallax
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☐ Alidades
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☐ Stands
☐ Tripods
☐ Repair of present instruments, (any make)

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From the MANUFACTURERS

ARMY TESTS HIGH-SPEED DITCHERS: Machines capable of digging 4-ft deep trenches at rates exceeding 20-ft a minute are undergoing tests at the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va. Manufactured by the Owen-Pewthers Co. of College Station, Tex. and the Barber-Greene Co. of Aurora, Ill., the rubber-tired units may prove extremely useful to the Army and the Civil Defense Administration in providing protection for personnel against flash burns or fragmentary bombs, and radioactive blasts. . . . **GIANT CANOPY:** Made of 40,000-sq ft of Porc-Lin-Ply, a huge "umbrella" is being raised in front of the shops at Green Acres Shopping Center, Valley Stream, L. I. A product of U. S. Plywood Corp., Porc-Lin-Ply is a rugged composite panel consisting of a 30 gauge, .012 porcelain enameled steel face, with semi-matte finish. The core is of ¼-in. exterior grade plywood with a metal backing to give balance to the panel. . . **STEEL CURBING FACING:** New York City is placing steel curb facing in heavy traffic areas in lieu of new granite curb. Nearly 700 tons of steel curb facing are now being installed along Third Ave. This steel is a new section rolled at Bethlehem's Steel Company's Steelton plant. . . . **ALL PLASTIC INDUSTRIAL WHEEL:** Lamilon nylon-reinforced all-plastic wheels on which patent is pending are the achievement of years of research, development and extensive field service tests. Manufactured by The Fairbanks Co., NYC, these wheels provide a new concept in the standardization on one type of wheel for all materials handling equipment in any section of a plant. . . . **ALUMINUM SALES PROMOTION:** The Aluminum Co. of America is undertaking a comprehensive and continuing program calling for the establishment of a Residential Building Products Sales Division, sponsoring and promoting, through the furnishing of plans and specifications, approximately 50 model homes and formation of a Residential Building Products Advisory Committee from among the best architectural and design brains in the field to solve problems and to develop new methods and products. . . **EXPANSIONS AND MOVES:** Insuro Chemical Co. of West Upton, Mass. has opened an office at 580 Fifth Ave., Room 219, NYC. They also appointed the Kinmar Export & Import Co., same address, their exclusive representative in the import and export field—Thor Power Tool Co. have opened their 27th branch office in Richmond, Va. marking the continuance of an expansion program—To expand its production of precision equipment for optical tooling, Keuffel & Esser Co. is opening a new factory at Cranford, N. J.—Superior Concrete Accessories, Inc. are now located in their new plant at 9301 King St., Franklin Park, Ill.

NEW EDITION!

CRSI
DESIGN HANDBOOK

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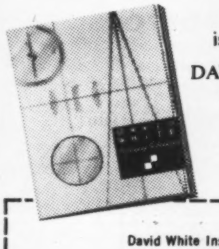

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February

1162. Measuring Streamflow Under Ice Conditions, by A. M. Moore. (HY) Effects of ice formation on stage-discharge relationships are explained briefly. Occurrence and effect of surface, frazil, and anchor ice are described, and recorder graphs registering these effects are shown. One investigation of "siphon action" is detailed, and factors affecting the accuracy of ice-affected records are listed together with a general appraisal of such accuracy.

1163. Pipe Friction Loss at High Pressures, by J. G. Slater, J. R. Villemonte, and H. J. Day. (HY) Pipe-friction tests were conducted at line pressures up to 2,000 lb per sq in. Friction factors are compared with standard pipe-friction theory for a range of Reynolds number of from 146 to 135,000 computed with viscosities measured by Stokes-Law apparatus, showing a small but consistent deviation for results obtained at 2,000 lb per sq in.

1164. Some Physical Problems Related to Flood Insurance, by A. Arthur Koch. (HY) Some of the technical and scientific problems, in the fields of meteorology, hydrology, and oceanography, of a nationwide flood insurance program are described. The solution of these problems will depend largely on theoretical and experimental knowledge accumulated within the past two decades.

1165. Technical Problems of Flood Insurance, by H. Alden Foster. (HY) Flood insurance is outlined from the engineering standpoint, with emphasis on determining flood probability from relatively short records, estimating mean annual flood damage to properties for establishing self-supporting premium rates, spreading the risk of flood damage over a large number of policies, and technical problems of setting up a program of flood insurance.

1166. Frequency Analysis of Streamflow Data, by David K. Todd. (HY) Frequency analysis of streamflow data is reviewed, and computational procedures are briefly outlined, but with a list of references. Frequency analysis of high flows (floods), low flows (droughts), and all flows are described. Figures illustrate methods of expressing and interpreting streamflow data subjected to frequency analysis.

1167. Butterfly Valve Flow Characteristics, by M. B. McPherson, H. S. Strausser, and J. C. Williams, Jr. (HY) Flow coefficients are given for free and submerged discharge and for two cases with enclosed flow piping. Effects of type of installation, blade shape, and closure angle for control-type valves (using water) are demonstrated. Correlation of analytical relationships with performance provides a basis for predicting incipient cavitation.

1168. The Sanitary Engineer of the Future, by T. V. Hatch. (SA) Rapid technological expansion is creating a field widely divergent from that of early civil engineering. The sanitary engineer must expand his knowledge of the newer aspects of technology as they affect invironment; the sanitary engineer of the future will meet these new and varied problems.

1169. Basic Considerations in the Measurement of Air Contaminants, by Wesley C. Hemeon. (SA) Conventional measurements of air contaminants are discussed as well as the filter paper black stain sampler and obtainable data.

1170. The Relationship Between Consulting Engineers and Industry, by David H. Miller. (SA) The salesman-customer relationship exists between engineers and industry. For the most part, the consultant supplies specialists to aid the industry in solving problems. This is done in a completely professional manner rather than a purely commercial manner.

1171. Effects of Storage Impoundments on Water Quality, by Milo A. Churchill. (SA) This paper presents and summarizes a wide variety of observations made on reservoir waters in the Tennessee Valley during the past twenty years. The facts obtained and the general principles deduced therefrom should help forecast the changes in water quality that are likely to occur in any proposed reservoir.

1172. Sludge Incineration, by Mark B. Owen. (SA) Sewage sludges are similar to low-rank fuels and may be burned without obnoxious gaseous odors. Chemical characteristics of wastes and combustion computations for sludge are provided. Multiple-hearth furnace operating data are tabulated and discussed. Preferred furnace design criteria are quoted, and the design and operation of the Nichols Herreshoff furnace are described.

1173. Sludge Digestion or Incineration, by Eugene R. Davis. (SA) The factors determining the economics of digestion versus incineration are so dependent on local conditions that no general conclusions can be reached for all

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1174. Calculation of MAC of Radioactivity in Air and Water, by Herman Cember and M. A. Shapiro. (SA) Radiation damage is proportional to absorbed energy, which provides a means for computing MAC values for many radioactive environmental contaminants. These values are based on a maximum exposure rate of 300 millirem per week, corresponding to the absorption of 30 ergs per gram of tissue for beta or gamma radiation. If the biological behavior of any particular radioisotope is known, then the maximum permissible contamination may be computed that would result in exposure at this rate.

1175. Selection of Sites for Atomic Energy Plants, by Arthur E. Gorman. (SA) Careful site selection for atomic energy plants is a most important advance planning function. The most significant environmental elements affecting site selection are the geology, hydrology, and meteorology of the area.

1176. SED Research Report No. 11: Status of Refuse Collection and Disposal, by The Sanitary Engineering Research Committee, Refuse Section. (SA) A preliminary survey was completed during 1955-1956 concerning the present status of refuse collection and disposal as well as future needs for additional research and development. The results of this investigation are summarized and evaluated.

1177. Discussions of Proceedings Papers 716, 826, 838, 1009, 1015, 1034. (HY) Joseph M. Caldwell closure to 716. W. B. Langbein and C. H.. Hardison closure to 826. Ven Te Chow closure to 838. J. E. Flack, John L. French on 1009. Guido di Ricco on 1015. Sam Shulits on 1034.

1178. Some Engineering Aspects of High Rate Composting, by John R. Snell. (SA) Composting, one of the least known methods of garbage and refuse disposal, is currently being considered as an important means of conserving natural resources and of disposing of solid wastes. Factors affecting high-rate composting are cited.

1179. Writing Engineering Specifications—For Quality, Not Price, by Morris M. Cohn. (SA) This paper shows that a major engineering problem in public works is specification writing because stress is too often placed on price rather than on quality. However, there is a tendency to improve specifications so that quality is first and price, second.

1180. Color in Industrial Wastes, by Nelson L. Nemerow. (SA) Modern theories of color formation are reviewed and summarized with special emphasis on the role of chemical structure in color development. Commercial dyes are classified according to their structure. The azo group of dyes, representing about half of the commercial dyes manufactured at present, was selected for experimental laboratory studies. Reduction with $SnCl_2$ and salting with NaCl were most effective in reducing and changing the color of methyl orange, a monoazo dye.

1181. Allegheny County Story of Smoke and Air Pollution Control, by T. C. Wurts and J. J. Grove. (SA) Ever since the 19th century, the Pittsburgh area has been troubled by air pollution. The development of smoke and air-pollution control in Allegheny County is an excellent example of what can be accomplished by cooperative efforts of an entire community.

1182. Arch Dams: Measurements and Studies of Behavior of Kamishiiba Dam, by H. Kimishima and C. C. Bonin. (PO) This paper, one of three, describes the actual behavior of the first large arch dam in the Far East. A description is included of the instruments, their arrangement, and the results of preliminary investigations. Data is presented on joint openings, deflections, stresses, and temperature variations in both concrete and foundation rock.

1183. Arch Dams: Construction of the Kamishiiba Dam, by K. M. Mathisen and C. C. Bonin. (PO) This paper, one of three, discusses the construction of the first large arch dam in the Far East. The construction plant and equipment, foundation excavation and grouting, quarry operations and aggregate production, concrete control, construction operations, contraction joint grouting, and the closure of the dam are described.

1184. A Supplemental Note on Valuation and Depreciation, by Maurice R. Scharff. (PO) This paper supplements two previous papers by the writer by citing the applicability of computations of equal sums, of present worths of annual fixed charges, and of operating expenses for alternative proposals to the solution of other engineering-economic problems and to the valuation and depreciation of public-utility property. Algebraic formulas and numerical examples are presented for a number of selected typical cases.

1185. Discussions of Proceedings Papers 639, 739, 895, 991, 997, 1042. (PO) Louis E. Rydell and Glenn H. Von Gunten closure to 639. William Whipple closure to 739. Glenn H. Von Gunten, Hugh A. Smith, Jr., and Berton M. MacLean closure to 895. Judson P. Elston on 991. Fred A. Houck on 997. James Park on 1042.

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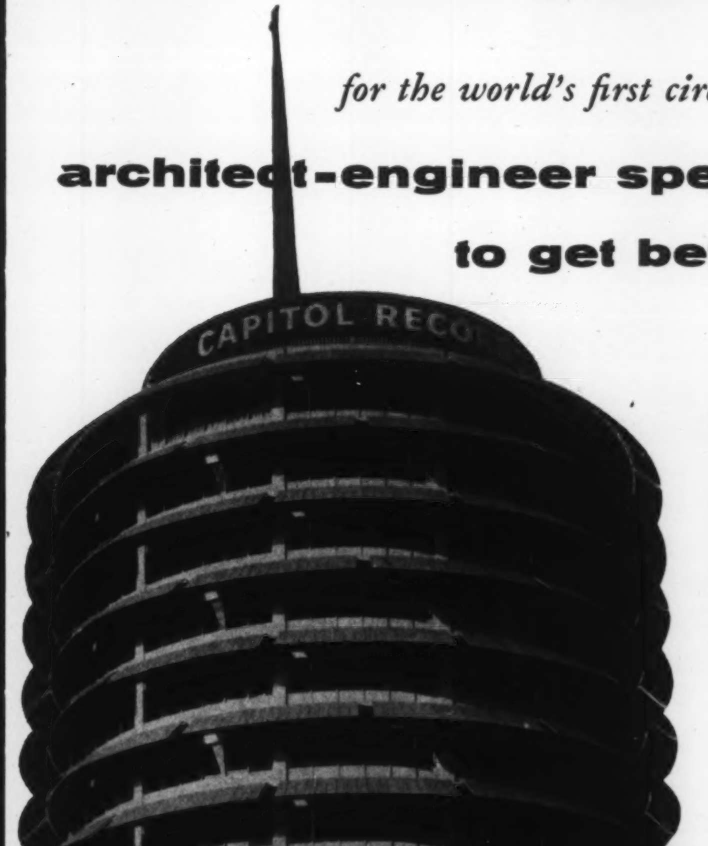

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